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China Report

SCIENCE AND TECHNOLOGY

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CHINA REPORT

SCIENCE AND TECHNOLOGY

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NATIONAL DEVELOPMENTS

PUBLICATIONS

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SSB RELEASES FIGURES ON SCIENTIFIC PERSONNEL, EXPENDITURES

Beijing RENMIN RIBAO in Chinese 21 Oct 86 p 3

[Text] Recent materials from the State Statistical Bureau show that there have been rapid developments in science and technology undertakings in this country recently, that our scientific and technical strength has rapidly expanded, that our level of science and technology has improved remarkably, that scientific and technical achievements have sprung up in great quantity, and that the gap between some of our scientific and technical fields and advanced world standards is currently being reduced.

The science and technology contingent has rapidly expanded

By the end of 1985, natural science personnel throughout the country (not including units affiliated with groups in the residential areas of towns, townships, and cities; this condition includes the following figures) grew to be 8.239 million people, which was an increase over the end of 1978 of 3.67 million; average yearly increase was 524,000, which was a 3.3 fold increase of the average over the previous 26 years of 159,000 people. In an average group of staff numbering 10,000, 667 are scientists or technicians, which is an increase of 1.5 fold and 0.4 fold over the 269 of 1952 and the 480 of 1978, respectively. The educational attainments of the scientists and technicians also improved.

Science research funding has grown rapidly

In 1985, research development expenses allocated from national finances were estimated to reach 9 billion yuan, a 0.7 fold increase over that of 1978. Per capita science research expenses were 8.6 yuan in 1985, a 1.5 fold increase over 1978.

Scientific and technical achievements have sprung up in great quantity

During the Sixth 5-Year Plan, there were 34,045 national major achievements recommended by 29 provinces, autonomous regions, and directly administrated municipalities and by 40 departments within the State Council. Among these, 2,834 were awarded national prizes. Among these prize-winning projects, 937 were national awards for invention, where after the invention was applied total increases in income or savings in expenditures came to 30 billion yuan;

there were 125 national natural science awards; 1,772 national awards for advancements in science and technology, which accounted for increases in income or decreases in expenditures of about 76.5 billion yuan. According to statistics from 23 provinces, autonomous regions, and directly administered municipalities and 18 departments within the State Council, among the scientific and technical achievements gained, 5 percent were of an international standard, 36 percent were of a domestically advanced level, 23 percent were of a provincial (ministry) advanced level, and 36 percent were of a generally advanced level. Some important technologies, as for example the launching of carrier rockets and the testing of communications satellites, have already reached or approached advanced world standards.

Two problems worth attention

The materials from the State Statistical Bureau brought up two problems worthy of note:

1. There is little income from scientific and technical undertakings, and vitality in science and technology is still lacking. A 1985 general survey of science and technology showed that in yearly expenses and income for research and development organizations in this country, income from efforts was only 28 percent, far less than the 75 percent of East Germany, the 75 percent of Hungary, and the 77 percent of Bulgaria. Institutes in the industrial sectors of these three countries have completely implemented contract systems and their economies are completely independent. This, while among the 4,068 institutes and research organizations affiliated with departments of our State Council and with provinces, autonomous regions, and directly administered municipalities, only 36.8 percent have instituted a technology contract system, and only 7.8 percent of which are economically independent.

2. In the aspects of quantity, quality, distribution, and utilization, there are still many problems with our science and technology contingent. If we include those people with middle vocational or ordinary middle school backgrounds, within an average group of 10,000 social laborers, only 165 are scientists or technicians, which is only 52.5 percent of the 314 in the United States (if lower educational achievers are not included, there are 75 among them, which is only 24 percent of those in the United States). Among the 7.817 million people in national public units, only 1 percent are high level scientists or technicians, only 17 percent are middle level scientists or technicians, and more than 80 percent are entry-level scientists and technicians. In an average group of 10,000 staff members, 870 in national public units will be natural scientists or technicians, while only 131 would be scientists or technicians in a similar group from collective units. Scientists and technicians in the numerous town and township enterprises are very few indeed.

12586
CSO: 4008/2008

NATIONAL DEVELOPMENTS

DECLINE IN QUALITY OF TECHNICAL WORKERS NOTED

Beijing ZHONGGUO JIXIE BAO in Chinese 9 Oct 86 p 2

[Report by Ge Yunchi [5514 6663 3069]: "Decline in Quality of Technical Workers Worthy of Note"]

[Text] At present, the proportion of managers and odd-job personnel generally present in machinery enterprises is rather high, while that of first and second line technical workers is low. However, even more serious has been the decline in the quality of the contingent of technical workers, which cannot but attract the attention of managing departments and enterprise leadership.

To take one large scale enterprise as an example:

There is a total of 5,531 first line production workers and second line auxiliary workers, which is only 59.4 percent of the total plant staff (and does not include apprentices, some 4.6 percent of the total staff, who are training for first and second line positions). Looking at ages, the average age for these technical workers is 35, so it may be said that this is a contingent that is full of vigor and vitality and in the prime of its life. Even so, from the aspect of educational quality, technical quality, and even ideological quality, there are many areas that are unsatisfactory.

Looking at educational quality: 40 percent of the technical workers have a high school or vocational school and higher education; 46.9 percent have middle school educations; and 13.1 percent have elementary school educations. Sixty percent of technical workers have a middle school or lower education, with which it is difficult to meet the demands of this large scale enterprise in developing precision, top-notch products.

Looking at technical quality: high level engineering school (7th, 8th level) 4.7 percent; middle level engineering school (4th, 5th, 6th level) 45.3 percent; and beginning engineering school (1st, 2nd, 3d level) 50 percent. This, while among middle level engineering students, a certain portion of them transferred there because of wage adjustments over the past few years, and the actual technical levels of some of them cannot meet corresponding technical requirements at all. In actual situations where beginning level engineering school students are in the majority, how can they meet the needs of the transition from the labor intensive to the technology intensive?

Looking at ideological quality: among these technical workers, nearly 2,300 (42 percent of the total number of technical workers) came into the plant within the last 10 years. Most of these technical workers did not qualify for college, did not serve in the military, and did not go to technical schools, the proper channels were not taken, but instead were employed through replacement or succession or through exams to fill jobs (which method of examination is notorious). Although among them there is no lack of talent for striving after self-advancement, many have chosen production work where "the grass is always greener on the other side," and lack the awareness or enthusiasm for "taking on a profession, loving a profession, and sticking to a profession." As for that kind of foundry or forging production work that is "bitter, filthy, tiring, and dangerous," even fewer are willing to sign up and those who do go into it always have other reasons for doing so, only getting into it because they are forced to.

Even in this technology contingent that is deficient in quality, 20 percent of them cannot take up positions in production due to deficiencies in technology or for physical or other reasons.

The quality of the contingent of technical workers has declined, and although this is due to historical reasons, we cannot let things run their course. There is no shortcut for solving these problems. On the one hand, by enhancing our efforts at a spiritual civilization and by beginning arduous and detailed ideological work, by caring for them, by being concerned about them, and by training them, we can allow them to truly realize the important significance of their particular work. This consequently will establish the ideals of taking root in one's job, producing accomplishments, and contributing to the four modernizations. On the other hand, by implementing the economic responsibility system, where policies permit this will provide them with greater material benefits, and encourage them to partake of the enthusiasm with which technology makes more contributions; at the same time, we must be willing to part with capital to create the conditions for them to study culture and technology, as well as to provide those of outstanding achievements with rewards. In summary, this problem of the decline in the quality of the technical workers contingent is completely capable of gradual resolution as long as we can attract the attention of pertinent departments and of enterprise leadership, and can also formulate vigorous measures that are truly feasible.

12586
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TREND OF DEVELOPMENT OF CHINA'S AVIATION INDUSTRY

Beijing GUOJI HANGKONG [INTERNATIONAL AVIATION] in Chinese No 11, Nov 86 pp 2-4

[Article by Huang Kemin [7806 0344 2404]]

[Text] China's aviation industry was first established 35 years ago. During this 35-year period, it has not only grown in size, but it has also evolved from primitive repair and imitation activities to full-scale design and manufacturing capabilities. Today, it has become an important part of the national economy, and is playing an increasingly key role in China's four modernizations program; it is also gaining recognition by technical communities around the world. In order to understand the history of our aviation industry and its current status, this reporter arranged an interview with the deputy minister of the Ministry of Aviation Industry and senior engineer, Comrade He Wenzhi.

Comrade He Wenzhi is 55 years old; he graduated from the Aeronautical Institute of Qing Hua University in 1952. As a young scholar first stepping into society, he had made up his mind to devote his career to China's aviation industry. Over the past few decades, he had made numerous contributions to the development, production, and flight tests of China's aircraft and missiles for sea defense. He had assumed the positions of chief quality inspector and designer of airplane factories, deputy chief engineer, director of missile design institute for ocean defense, and director of the institute of helicopter research. He had also been responsible for leading the flight test activities for new aircraft and for organizing the work of developing new aircraft and missiles. His contributions can be found in many of the aircraft and missiles which are used by today's Air Force, Navy, and civil aviation services. In the process of developing new aircraft and missile models, he often participated in person to coordinate the research, production and service activities and to organize the Party officials, engineers, and technicians. He applied the most advanced planning and evaluation methods and system engineering techniques in carrying out project work. He was truly a practical engineer and administrator in the aviation industry.

In 1980, Comrade He Wenzhi was promoted to be the deputy minister of the Ministry of Aviation Industry. Before reporting for duty at his new position in Beijing, he flew directly from Jiangxi to Shanghai to lead the flight test team for the Chinese-built passenger plane, the "Y-10." He organized and led a team of specialists, engineers, and scientists to conduct a detailed review of every technical problem of the "Y-10." After more than a month of dedicated efforts,

he sent a telegram to Beijing giving his personal guarantee that it would be safe to carry out Y-10's first flight test. The flight test was a complete success.

According to Comrade He, China's aviation industry was established in April 1951. In the First 5-Year Plan of 1953, it was designated as a key issue of national priority. As a result of dedicated efforts by every member of the aviation industry and early assistance provided by Soviet technical consultants, a number of aircraft were successfully developed. They included the "CJ-5" trainer in July 1954, the "J-5" fighter in 1956, the multipurpose transport "Y-5" in 1957, the "CJ-6" trainer in 1958, and the supersonic jet attack aircraft, the "J-6" in 1959.

Such a high growth rate was not only unimaginable in old China, but also considered a major achievement in world aviation history.

Then, Comrade He began to talk about the grave issue of disruptions to aviation development and damages done by the "left wingers" during the period of the "10-year chaos." He felt particularly sorry about the loss of valuable time, the widening gap between China and other developed nations, and he deeply missed the old comrades who passed away during the "10-year chaos." Specifically, he said that well-known designers such as Xu Xunxhou and others would certainly have made further contributions to the aviation industry if this country had not been misguided by the wrong policy. It was precisely the dedicated efforts and labor of these old comrades and technical experts that built a solid foundation for China's aviation industry.

He also pointed out that after 35 years, China's aviation industry has become an industry of significant size; it has also developed a complete system with specialized segments of research, production, and education. Facilities for experimental research are being built, new accomplishments of research are being reported and the number of Chinese-built aircraft models is increasing daily. A variety of aircraft have been produced: interceptors, bombers, attack aircraft, helicopters, transports, surveillance aircraft, trainers, multipurpose aircraft, unmanned aircraft, and ultra-light airplanes, as well as many different types of tactical missiles which are being used by the Air Force, the Navy, and by friendly nations. Furthermore, the production capability and advanced technologies of the aviation indurtry are playing an increasingly important role in the national economy through their contributions in technology reform, in the light industrial market, and in foreign trade.

China's aviation industry was built on the principle of independence and self-reliance. The industry has always been interested in technical exchanges and cooperative activities with other countries; in recent years, the level of these activities has increased drastically. To comply with the open-door foreign policy and flexible internal policy, the aviation industry actively promotes exports as well as importation of foreign technologies. Many aircraft companies and engine manufacturers in the United States, Great Britain, Canada, West Germany, and Italy have signed contracts with China to fabricate aircraft and engine parts. The Chinese aviation industry is favorably regarded by foreign companies because of its credibility in fulfilling contractual agreements and its emphasis on quality.

Looking back into the past, we must try to build on our successful experience and also learn from the lessons of our failures. Looking at the future, we still have a long road ahead of us, and we must take on the task of developing an aviation industry with unique Chinese characteristics. We must try to narrow the gap in technology between our country and developed nations in the shortest possible time. It is our national goal to double our industrial and agricultural output by the end of this century. But what about our aviation industry? What should be our goal? How should we apply our technical capabilities to enhance economic and social benefits? These are questions which deserve our serious consideration. We are now going through a period of paus and exploration. We must learn from the writings of the ancient Chinese scholar Chu Yuan and the famous author Lu Xun in developing a uniquely Chinese aviation industry.

In recent years, the policies and concepts for China's aviation industry are undergoing an evolution. In October 1981, Comrade Deng Xiaoping indicated that: "We must consider building our own airplanes for domestic airlines." Two months later, he again emphasized that: "In the future, we must use Chinese-built airplanes for domestic civil aviation." As a result, active development of civil aircraft has become a national guideline and policy. Later, Premier Zhao Ziyang proposed that: "We must devote our efforts to developing special-purpose airplanes and feed-line airplanes. We will dictate that airlines use exclusively Chinese-built small airplanes for their feeder routes because this will stimulate the growth of China's aviation industry." General Secretary Hu Yaobang gave his blessing, hoping for a major breakthrough in the development, production, and service of Chinese-built aircraft in the 1980's. Motivated by the encouragement of central government leaders and guided by the new policy, China's aviation industry has reached an unprecedented new plateau in recent years. It is clear that the key to achieving rapid growth in the aviation industry before the year 2000 is to develop civil aviation.

Comrade He pointed out that a modern airplane is a highly complex system. Building an airplane requires the cooperation of many different industries around the country. The fact that China is capable of supplying its own materials and accessories is a result of integrated efforts of hundreds of factories and research organizations in the metallurgical, chemical, machine-building, and electronics industries. Their contributions must be given full credit for any accomplishments in the aviation industry. Therefore, to achieve rapid growth in the aviation industry, these lateral lines of communication and cooperation must be solidified and further developed.

In addition, we should also actively pursue the policy of international cooperation; we should try to develop our own new products by digesting and improving imported technologies. If there is a significant gap in a particular technology which is urgently needed by our "four modernizations" program, then we should try to acquire this technology by purchasing the patents and rights in order to minimize development time. Once acquired, we would then devote a great deal of energy in understanding and absorbing this technology, and in trying to improve and develop it for the purpose of developing our own products.

For example, we are now cooperating with the United States to improve the fire control system on attack aircraft; in Shanghai, we are cooperating with McDonnell-Douglas to produce and assemble the MD-8 passenger plane; in the area of helicopters, we have imported the advanced "Dauphin" helicopter from Aerospatiale of France, and have incorporated our improvements to the French model to develop our own helicopter. Currently, this helicopter is being used for the exploration of oil fields in the South Sea.

In order to promote and develop our aviation industry, we must set our priorities and continue to import advanced technologies on a selective basis. In view of China's limited resources, we are willing to cooperate with foreign countries to develop export-quality aircraft by combining each country's strength. For example, we have cooperated with Italy in converting the attack aircraft. In recent years, China's aviation industry has signed agreements of technical cooperation with research organizations and universities in countries such as the United States, England, France, West Germany, Italy, and Romania where both sides would send their technical experts to the other country to participate in their academic activities. Experience has shown that such mutual cooperation is very effective in raising the technical standards of aviation, particularly in resolving specific technical difficulties. The technical cooperation with West Germany and Sweden also produced good results.

Comrade He proceeded to discuss the problem of quality control of aviation products. He said that "quality first" is not only a conclusion we have reached from our experience, but it should also be our firm policy for the future. The problem of quality control in aviation products is of particular importance and deserves our special attention because it concerns the safety of human lives and properties. To improve quality, we must concentrate on building foundations and establishing standards. To establish quality standards, we should adopt international standards and the standards of developed nations. This is a major undertaking: we must raise our level of awareness, improve our existing systems and conditions, and implement realistic work procedures. Currently, the Xi'an Aircraft Co. is fabricating aviation parts for the Boeing Airplane Co. and the Shanghai Airplane Factory is assembling the MD-82 airplane, both according to requirements of U.S. aviation standards. If the Chinese-built "Y-12" is to break into the international market, it must first be designed to meet international standards. For this reason, we invited representatives from Lockheed to participate in the flight tests in order to ensure that the airplane will comply with international standards and be able to qualify for international flight certification.

In order to establish an aviation industry with unique Chinese characteristics, we must implement quality control techniques for all industries. We must form a small feedback circuit through quality legislation, quality monitoring, product inspection, and quantitative examination; we should also form a large circuit through field feedback and improved field service. Only by developing a complete system of scientific quality control procedures can we ensure the quality of our products and establish a long-lasting reputation in the international market.

According to Comrade He, many of the Party officials and technical personnel participated in dangerous flight test missions along with the test crew. This is not only an indication of their dedication to their jobs, but also reflects their confidence in the flight safety due to the use of scientific quality control procedures.

With regard to industrial reform, Comrade He said that we should emphasize coordinated activities in the following two areas. One is to coordinate the activities across different regions and different organizations to meet product requirements. This can be achieved by establishing a four-dimensional management and responsibility system which consists of an executive command system, an overall design system, an overall accounting system, and a quality management system. The other is to coordinate the supply of materials, labor, factory space, and facilities. For example, in developing feed-line passenger planes, we will first determine the optimum point in the three-dimensional coordinates of technology, economy, and schedule; then we proceed with a four-dimensional management approach which consists of technology, economy, schedule, and quality. Every system on each coordinate is related to the other systems, thus forming a system engineering network which serves as a basis for management.

In discussing the problem of manpower requirement and training, Comrade He said that it is essential to find qualified people to carry out the open-door foreign policy and flexible internal policy. Currently, the critical manpower shortage is in the areas of sales, management, and legal personnel. We must change our traditional concept and adapt to the modern world of planned economy and market competition. We should hire spirited sales people to develop new markets and increase product demand. Management personnel, particularly high-level managers, must have the courage to carry out reforms; they must have a broad knowledge and the ability to organize and unite other people. Because the aviation industry is a technology-intensive and knowledge-intensive industry, aviation products are the result of combining many different disciplines of knowledge and technologies. Therefore, we must mobilize and coordinate all these efforts using complicated system engineering approaches. As we continue to expand the open-door foreign policy and implement more flexible internal policy, we must consider the legal implications of such activities as product specification, quality management, product sales, signing of contracts, and recruit lawyers to conduct these activities.

In closing, Deputy Minister He said that the strength of a country is indicated by the strength of its aviation industry; therefore, it not only plays an important role in military development, but also provides tremendous economic and social benefits. As the four modernization program continues to march forward, there is no doubt that China's aviation industry will blossom before the end of this century as long as we insist on an open-door policy and internal reforms.

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REPORT ON S&T ORGANIZATIONAL RESTRUCTURING

Beijing RENMIN RIBAO in Chinese 4 Oct 86 p 3

[Text] Not long ago, the National Research Center for Science and Technology for Development issued a report discussing development trends for developmental institutes in this country. The report, signed by Hu Ping [5170 1627], Ye Dan [0673 0030], and Liu Zhong [0491 0112], states that with the deepening development of the restructuring of the economic and science and technology systems, and especially with the strengthening of market mechanisms, developmental research structures in this country are just now in the process of breaking up and reorganizing. Undertaking overall research and design regarding the question of where research structures are going has already found its way onto the agendas of leading departments.

The report considers that to further strengthen the various forms of association or integration of institutes with enterprises and to greatly develop professional and regional technology development centers are important matters for the future restructuring of developmental science research structures.

The Research Center this year did a survey of more than 300 institutes and enterprises, feeling that the forms that have already been created for the integration of institutes with enterprises are actually the embryos of future institute models. These forms include:

Science research and production associations having different levels and different categories.

Some technology strong institutes are currently developing into professional technology development centers, as for example the Guangxi Pharmaceutical Institute, the Textile Institute, and the Mumu Institute.

A group of independent or factory affiliated institutes, catering to small to medium enterprises, have become regional small to medium enterprise technology development centers, as for example the Beijing Institute of Powder Metallurgy and the institute affiliated with the Beijing Music Instrument Factory Company and the Glass Head Factory. In Heilongjiang there are 112 centers of this sort.

Some new forms of science research technology development companies are just now emerging. Products from the company created from the association of the Die Institute affiliated with the Shanghai Jiaotong University and the Shanghai Handicraft Associated Communes have already entered international markets. Several new types of technology development and service companies have appeared along the well known "Haidian corridor," which could develop into the "science parks" and "brain trusts" of the future.

Science research and production "trusts" are just now sprouting up that are trans-profession, trans-departmental, and trans-regional.

Because of mutual needs, a group of independent institutes and small to medium enterprises are merging on the basis of equality and mutual benefit. The Dalian Institute of Electronics has merged with the Dalian Radio Factory No 13, and the institute has provided new technology while the factory is providing intermediate testing conditions and labor.

The report did not approve of simply merging institutes with enterprises as the only form for restructuring, but pointed out that the combination of institutes with enterprises is not a simple organizational merger, being instead the combination of advantages, which serves to make the most of strengths while avoiding shortcomings. Only under the conditions whereby the mutual needs of the factory and institute, voluntary participation and mutual benefit, the labor of scientists and technicians are all respected, whereby technical advantages are made the most of, and where there is strong leadership can this method of merging be used.

The report recommended that the current readjustment of science research structures should adopt the principles of "multiple forms, guiding action according to circumstances, creating conditions, and when conditions are ripe success will come," where not everything can be treated the same way. According to estimates in the report, during the readjustment, because of weak technology, lack of capacity for research and development, and no vitality in competition, about 10 percent of local institutes will be closed, halted, merged, or transferred.

12586
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PROGRESS IN RESEARCH, PRODUCTION ASSOCIATIONS REPORTED

Tianjin JISHU SHICHANG BAO in Chinese 9 Sep 86 p 1

[Report from manuscript provided by the Office of Economic and Technical Cooperation, State Economics Commission]

[Text] Since this year, with the gradual penetration of the restructuring of the urban and township economic system in this country, lateral economic associations have broken through the barriers of the old economic system, and have broken through the state in which obstacles were created, departments isolated, cities separated from townships, production divorced from science research, and where there was a chasm between the military and civilian. These trends are deepening and broadening.

For one thing, lateral economic associations have become the focus of restructuring this year. After the nationwide conference on urban economic system restructuring efforts in March, several provinces and cities, such as Sichuan, Hubei, and Shanghai, summed up the real situations in their areas, and in line with local conditions worked out detailed plans and methods to implement the State Council's "Provisions Regarding Some Problems in Further Promotion of Lateral Economic Associations" to create a good atmosphere and environment for developing lateral economic relations.

Second, the results from lateral economic associations and cooperation are outstanding. For the first half of the year, according to incomplete statistics from the 12 provinces and cities of Heilongjiang, Jilin, Liaoning, Fujian, Jiangxi, Shandong, Henan, Hunan, Guangzhou, Chongqing, Shaanxi, and Gansu, more than 13,200 projects for economic and technical cooperation had been agreed to, 10,400 of which have already begun, which is 79 percent; total funds that are to be brought in and merged reach 2.62 billion yuan, 1.44 billion of which has already been implemented, which is 55 percent, and more than 14,500 people have been exchanged.

Third, the position and effect of lateral economic associations in the national economy have been rising steadily. As of now, the city of Changzhou has set up 56 enterprise groups, the output value and taxes on profits of which in the first half of the year were 32.8 percent and 40 percent of the entire city industrial output value and taxes on profits, respectively.

Fourth, different forms of economic associations and organizations have appeared in great numbers. The scope of association is broader and broader, and these have developed from the industrial, transportation, scientific and technical, and goods and materials to the particular fields of agriculture, commerce, metallurgy, culture and education, and hygiene. There is a special tendency as the lateral associations develop toward multiple levels, greater breadth, and multiple directions, for there to be new forms of enterprise organizations with large scale key enterprises at the head, and these will gradually develop into rather powerful economic entities. As for example the Yi Qi, Er Qi, and Jialing blocs. This will provide very valuable experience for changing enterprise and organizational structures in this country, for establishing very vigorous production entities from these blocs, and for exploring new enterprise management systems.

Fifth has been the further solidification and development of regional associations. This year, all regions established things like the Bohai Sea Economic Area Mayors (Commissioners) Joint Conference, the Nanjing Regional Economic Coordination Conference, the Yan-Bei Economic Cooperation District. According to incomplete statistics, 23 economic cooperation district networks that are trans-provincial and trans-city have been established throughout the country, which has promoted the formation and development of regional economic networks in this country.

Sixth is where a group of scientific and technical achievements has been transformed into production forces. There are now more than 10,000 research and production association of all sorts in this country. Through the association of research and production, Heilongjiang Province developed more than 2,300 new products, among which 225 were of an advanced domestic standard. There are 247 production research associations in the city of Shenyang, and last year 23,000 technical contracts of all kinds were signed, for a volume of transactions of 470 million yuan.

Seventh was the promotion of urban and township economic coordination. Urban enterprises extended out to associate with rural and township enterprises, which stimulated development of the rural economy. Thirteen cities in Jiangsu Province brought together their urban and township economies, motivating the gradual inclusion of town and township industry onto the track of overall control. 1985 production value has reached 36.3 billion yuan, and tax revenue to the state is nearly 2 billion yuan.

Eighth has been the integration of the military with the civilian, where there has been great development in first and third line cooperation. In April this year, the Office of Third Line Planning of the State Council and the Office of Planning for the Shanghai Economic Zone joined to hold a conference on first and third line regional economic and technology cooperation. After discussions, 190 contracts and agreements of intention were signed, for a money value of 400 million yuan. Military industrial departments have made the most of their advantages in equipment and technology to strengthen ministry and provincial cooperation. The Ministry of Ordnance reached separate association agreements with provinces such as Shaanxi and Shanxi, as

for example where agreements were reached with Shanxi Province to carry out cooperation in the fields of coal mining machinery, technology importation in industries such as industrial chemicals, technology transformation, and the development of new products.

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IMPORTANCE OF IMPORTED MANUFACTURING TECHNIQUES DISCUSSED

Beijing ZHONGGUO JIXIE BAO in Chinese 14 Oct 86 p 3

[Report by Lin Guochang [2651 0948 2490]: "Pay Close Attention to Manufacturing Techniques for Machinery in Order to Promote the Development of Technology Importation"]

[Text] In recent years, through the importation of technology, the heavy duty machinery industry has manufactured a batch of products that are of international standards of the late 1970's and early 1980's. By importing technology and cooperative production, this has remarkably shortened the period for product renewal and replacement, which has stimulated technical advances within the industry. However, the importing of technology has still proposed a full scale challenge for backward manufacturing techniques. For example, in the areas of machining and assembling, the hardening of gear teeth and gear wheels, numeric control technologies, composite cutter systems, and parts configuration assembly and testing were all begun only with the stimulus of initiation of the importing of technology and cooperative production. Due to gaps in the levels of techniques and equipment, for sets of equipment produced cooperatively during the Sixth 5-Year Plan the responsibility in this country was for the most part to manufacture metallic constructional elements. But there are gaps in the levels of our techniques and equipment even for manufacturing metallic constructional elements of a modern standard. The gap is even greater for painted and coated assembly techniques. It may be said in light of the circumstances just mentioned that at the same time as we import technology, we must take vigorous measures to learn manufacturing techniques before we can further the improvement of our levels of technology, and I will now present a few opinions on problems in these areas.

Integrate the importation of technology and determine the focus of advances for techniques and technology.

Manufacturing technology that has already been imported is largely of a standard from the late 1970's and early 1980's. The renewal of domestic products has also focussed on this level. Therefore, integrate and take control of the needs for importing technology, select the foci for technique and technology advances, and at the same time take care of the needs for general product renewal and improvement of quality.

In the face of the development of heavy machinery toward the large scale, highly efficient, and automated, the trends toward improvement in parts and component machining and assembly precision, the need to sum up the particular requirements for integrating and controlling the importation of technology, and summing up the common problems regarding techniques may all be characterized in the following points: 1) welding technology, to include the entire process of metallic constructional parts; 2) applications of digital display and numeric control; 3) low speed, heavy load manufacturing technology for hardening gear tooth surfaces and gear wheels; 4) use of composite cutters; 5) component assembly and testing; 6) overall prefabrication and debugging; 7) surface processing technologies; 8) machining of blanks; 9. take power station cast and forged parts as representative large scale cast and forged parts manufacturing technologies.

We should systematically study and resolve interrelated problems in regard to each technique and technology. As for example personnel training, standards, regulations, equipment, inspections, tools, new materials, research, economically reasonable production scales, specialization and cooperation, safety and environmental protection, energy conservation, labor organizations and management, etc.

Use technology policies and standards to promote advances in techniques and technologies.

At present, enterprises in the heavy machinery industry, faced with improving product quality, have taken charge of the absorption and importation of technology, have each formulated plans for technique and technology transformation, and some have already begun to implement these things. As for example with the transformation of welding technology, the use of numeric control technologies, and the dissemination of digital display technologies, which are all generally required; large scale heavy machinery factories require a resolution of the manufacturing technology for hardening gear teeth and gear wheels, which is also quite common. To avoid a lack of experience or rushing headlong into action when initiating projects, or misdirection, guidance, organization, and coordination should be enhanced for the industrial efforts. In reference to work in techniques, the most important thing is to make the most of the function of enterprises, research structures, and professional activity organizations. The key to professional management should be the control of two items.

One is to organize and formulate policies for techniques, technologies, and equipment. The other is to organize and formulate standards for the various techniques, to use advanced, systematic standards for techniques, and to legislate regarding the undertaking of overall management.

Technology transformation should closely accommodate the demands of advances in techniques and technologies.

In commercial negotiations with foreign interests regarding cooperative production and the importation of technology, the Taiyuan Heavy Machinery Factory and the Dalian Heavy Equipment Factory made efforts to consider the question of improving their levels of technique. As they were signing

agreements with the foreign commercial interests, they bought some of the required key equipment, such as numerically controlled cutting equipment, photoelectric tracking cutting equipment, numerically controlled and digitally displayed devices, etc. Because of the attention of the State Economics Commission and the Ministry of the Machine Building Industry, and with the help of research academies and institutes, over the last few years these two enterprises have gained results in technical advances and the transformation of technology. Income results have been outstanding. They have added techniques, technology, and equipment for surface processing, precision cutting (the Taiyuan Heavy Machinery Factory has also added computer aided assembly of materials technology), mixed gas shielded welding, and low alloy, high strength steel welds. The welding node for offshore oil platform pipe developed by the Dalian Heavy Machinery Factory has reached international ship inspection standards and gained the approval of the State Office of Ship Inspections (ZC). Regarding the 16 cubic meter excavator main arm and caterpiller belt frame welded by the Taiyuan Heavy Machinery Factory, the quality is in complete accordance with the requirements for imported technologies and has been praised by personnel of the P&H Company, which is providing on the job guidance. At present, both factories have the level of technology with which to manufacture current international level welded construction parts, and can serve as model locations in regard to precision cutting and gas shielded welding.

The actual example of the aforementioned two factories shows the intimate relation between the three areas of importing technology, techniques and technological advances, and technology transformation and their complementary function.

Be aware of the consistency between the levels of technological advances and economic results.

Theoretically speaking, improving the levels of technology and increasing economic results should be the same thing. But the inappropriate seeking after advances or a blind demand for perfection in techniques and in equipment can lead to waste. Therefore, in the process of technique and technological advances, besides encouraging and promoting the use of new techniques and new equipment, we should also stress the consistency between technique and technological advances and economic results. From the point of development, enterprises all want to gradually practice value engineering and goal costs, for which efforts in technique should create the conditions. It is even more important to do feasibility studies on technology transformation programs that make use of new techniques.

To disseminate advanced techniques, we must at the same time enhance enterprise management.

Although some enterprises have imported advanced technology, they have not been able to produce high quality products, for aside from gaps in technique and technology, backward enterprise management is also an important factor. This point has yet to attract universal attention, for once technique and quality problems are discussed the focus is invariably on technology and equipment. But in production, not only are many quality problems not due to

technical factors, but are created by lack of strict discipline in technique and disorderly management. As for example the correct transmission of material quality brand name or furnace number in the processing of parts, and reliable temperatures for low hydrogen electrodes in the process of storing and taking them out; (GONG KA) measurement tools and the means for test monitoring to regularly maintain normal states of technology; or the prevention of harm due to bumping or of loss of precision processing parts, all of which are very complex technical problems. The key is in having perfect and effective management as a guarantee. This is even more important for the heavy machinery industry that produces a wide variety of products singly or in small batches.

12586
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EFFORTS TO MODERNIZE FORGING TECHNOLOGIES URGED

Beijing ZHONGGUO JIXIE BAO in Chinese 19 Aug 86 p 3

[Report by Xie Guangyao [6200 0342 5069]: "Develop Forging Technology to Raise the Level of Forge Production"]

[Text] Forge production directly affects the development of all sectors of the national economy, especially the production capacity and level of techniques for large cast or forged parts in all kinds of large scale key equipment and various precision forged parts. It is one of the important indexes for industrial levels in this country.

According to statistics from 1981, there were 3,900 forging factories or sites in 41 cities throughout the country, with approximately 17,000 pieces of forging equipment and an annual forging capacity of 2.8 million tons. The output quantity for forged parts in 1980 was 1.08 tons, which was 37.5 percent of actual annual production capacity. These forging factories and sites and the equipment capacities have had an important role in the development of our vehicles, tractors, construction machinery, shipping machinery, ordnance machinery, and space navigation equipment. Over the past few years, through cooperation between units in science research academies and institutes and higher educational institutions on the one hand and production and enterprise units on the other, the new techniques and new technologies for forging that have been jointly developed have been disseminated and applied in production. Several hundred kinds of parts use the high quality, highly effective cold-hot extrusion technology; the planetary gears in vehicles and tractors and parts such as helical bevel gears, synchronizer gear tooth rings, and blade elements have used precision drop forging technology, and steel balls, bearing rings, twin gear blanks, and electric machine axles have used a special rolling technology; and there have been many parts that have additionally used precision impact cutting and superplasticity technologies. Dissemination of these (SHAO WU) cutting and processing technologies have brought excellent economic results. In 1976 alone, the machinery industry system nationwide saved about 150,000 tons of steel, which was 4.3 percent of the amount of steel used in the national machinery industry. After the Changzhou Gear Factory adopted a gear blank precision forging technique, they manufactured 300,000 tons of forged parts in 1985, gaining economic results of nearly 200,000 yuan. During the period of the Sixth 5-Year Plan," forge (SHAO WU) cutter problem solving was carried out on some precision, top quality products

that are complex in shape and quite difficult, from which were obtained pleasing results. As for example the successful research into a shaping forger technology for the 700 mm long final stage blade element of a 200,000 kw turbogenerator to take off only 0.5 mm from the blade, which was the first time such a thing had been done in the world. In comparison with foreign precision forging, the cost was 50 percent lower and a great deal of foreign exchange was saved. Motor vehicle synchronizer gear tooth ring precision forge and shaping technology is already being used in production, has been awarded a national prize for technological advances, and titanium alloy air bottle superplastic shaping technology won a national prize for inventions...

Although research into forging production and new techniques for (SHAO WU) cutting have made great advances, there is still a gap when compared with industrially developed countries. This is primarily evident in the facts that aside from the forging plant (workshops) of a minority of large scale enterprises where the level of equipment and techniques is rather high, the majority of production equipment at small to medium forging factories and sites is still centered on the hammer, and where the primary techniques are free forging and die block forging. This is a machinery system where the proportion of drop-forged parts among forged parts is low, at 26 percent, while in countries like Japan and the United States it is about 60 percent. There has not been great dissemination of the new techniques for forging (SHAO WU) cutting. Generally speaking, the level of forging technology is rather low. Heating equipment consumption of energy is great, there is a high coal to iron ratio, the domestic average being 0.7 tons of coal per ton of forged parts, while abroad that is from 0.15 to 0.3 tons of coal per ton of forged parts. Because equipment is obsolete and level of techniques is low, the utilization rate for materials is also low. The problems in the forging industry of heat, filth, and fatigue have never been satisfactorily resolved. To improve the level of technology for the entire forging industry and to meet the demands of developing trends, we must make efforts to resolve the following areas:

1. We should handle well the relations between good products and basic techniques, and should respect the development and improvement of basic techniques. Machinery product quality is deficient at present, one of the chief reasons for which is that those basic techniques are backward. According an investigation into problems of quality for 194 key parts and components in Tianjin, it was found that the effects of equipment factors was only 8.37 percent, while the effect of technique factors was 81.33 percent. Therefore, to improve product quality, we must begin with taking control of basic techniques, turn around the tendency to emphasize product design over technique, and thoroughly take charge of work with techniques.

2. Speed up the technology transformation and renewal of existing forging equipment that is obsolete and highly energy consuming. Increase drop-forging equipment and improve the proportion of drop-forged parts. Increase the proportion of hot die forging mechanical presses and friction presses, develop some highly effective, high precision forging equipment, and improve the levels of mechanization and automation for forging equipment. There should be more attention paid to the development and production of specialized equipment for the new technology of forging (SHAO WU) cutting and accompanying

technology and equipment. Develop research and manufacture of (SHAO WU) oxidation heating equipment.

3. According to predictions by the International Association of Machining Technologies, by the end of the century there will have been great developments in forging (SHAO WU) cutting. By 1990, 50 percent of precision metallic parts will be produced with forging methods, and by the year 2060, a combination of forge machining and grinding will replace a great deal of cutting machining. Therefore, we must in this country quicken the pace of science research and vigorously develop research into the new techniques of forging (SHAO WU) cutting so that as soon as possible we may disseminate and apply the science research achievements that have already gained outstanding economic results in production. During the Seventh 5-Year Plan, we should energetically develop and research new forging techniques to improve product quality. As for example bearing ring precision tossed pressure technology, the precision forging technology for steel integral key casing gear tooth enclosures, precision impact technology for high strength steel plates and serrated parts, precision shaping technology for arched parts, and precision cutting technologies for bearing steel. Research for these new technologies will allow development of forging technology in this country to enter a completely new stage.

To promote the development of science research efforts, we must strengthen and replenish the construction of science research experimental bases to enhance research into basic technologies.

4. Rapidly develop die computer-aided design and computer-aided manufacturing technologies to improve the levels of die construction design and of die manufacturing. Establish die CAD/CAM centers to engage in development research for various die CAD/CAM series software.

We firmly believe that if we only earnestly analyze and solve the problems in actual practice we will promote progress in the new technologies and techniques of forging; and we will make them meet the needs of our drive toward modernization.

Photo caption: To meet the needs for development of numeric display in machine tool equipment, the Beijing Machine Tool and Electric Appliance Plant No 4 in 11 months time successfully developed the models GZD-1 and GZH-1 linear induction synchronizers. After production and testing, results were good and there has recently been a technical evaluation in Beijing. The evaluation committee felt that the technical indexes for this linear induction synchronizer are in keeping with the requirements of national standards. The successful development of this kind of induction synchronizer not only fills a void in the Beijing area, but will have an important role in unifying the development of machine tool production in the capital toward the electro-mechanical and in hastening the technological transformation of equipment.

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GOALS OF RESEARCH INSTITUTE STRUCTURAL REFORM DISCUSSED

Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 4, Oct 86 pp 42-44

[Article by Yu Renbo [0060 0088 0130] of the Shandong Provincial Commission of Science and Technology: "A Probe of the Goals of the Structural Reform of Research Institutes"]

[Text] The goal of the structural reform of research institutes is to enable research institutes to gradually become research and development entities that are geared to society and full of energies. In operational mechanisms, research institutes should gear themselves to the needs of the reform of the funding system and of opening up a technological market and use economic levers and market regulation to generate the ability to develop themselves and the energy to volunteer service to economic construction; in organizational structure, they should change the situation of separation from enterprises, vigorously strengthen horizontal cooperation and association, reduce the cycle from scientific research to production, increase the comprehensive social and economic results of scientific research, and accelerate economic revitalization and development; in the personnel system, they should solve problems concerning the rational circulation and use of talented people and bring about a lively situation in which everybody's abilities and talents are utilized fully and talented people keep coming forth in large numbers.

Since research institutes are different in ownership systems and types, their structural reform should advocate diversity, not uniformity. However, in general, to establish a research institute system that is geared to society and full of energy and vitality, they should mainly have the following specific goals:

1. Change Funding System and the Management of Scientific Research Funds and Practice the Commercialization of Technology

For a long period of time, we have adopted the method of "supply system" in regard to the funds of scientific research undertakings and the use of S&T results, and research institutes have had only one vertical system that holds them responsible to higher levels without any channels leading to society or serving production units. Research institutes are not concerned about production or the application of technology in production, adversely affecting

the voluntary combination of science and technology and production. To change this situation, we must reform the existing funding system. The key to the reform of development and research units is to implement the remunerative contract system; scientific research units engaged in basic research and some applied research should start with the reform of the fund management system, change the previous practice of allocating operating funds according to the number of staff members, gradually implement the system of scientific funds, and support those outstanding research projects which are chosen after being evaluated through a nationwide public bidding system. Appropriations for operating expenses should be reduced annually according to the degree of self-sufficiency, and some appropriations may be used under a contract.

In the management of research funds, attention should be paid to economic results. We must adopt an administrative point of view toward development and research, exercise scientific research administration-style management, emphasize low input and high output, emphasize the comprehensive social and economic results of research results, and consider the dissemination and application of research results as the ultimate aim. As for that basic and applied research which is not aimed at direct profits, there is also an issue of input and output which also demands low input and high output. Speaking in this sense, there is also an issue of economic point of view. At present, through the implementation of the remunerative contract system, some research units engaged mainly in development, research, and the dissemination of research results have managed to become self-sufficient financially with the road of scientific research administration becoming wider and work livelier.

The commercialization of S&T results is the precondition for the reform of the funding system. Without the compensated transfer of technological results, scientific research undertakings would not have the condition to reach self-sufficiency or basic self-sufficiency in operating funds. Since China practices a planned commodity economy, to make S&T work serve production, we must admit that technological results are disembodied commodities. The broader the scale and the greater the number of such exchange is, the more developed the commodity economy and the faster the progress of S&T work will be. We should not think the technological market is non-essential, still less should we think research institutes selling technological results to gain legal income as a new unhealthy tendency. In fact, going all out to develop and vigorously support the technological market and making great efforts to do a good job in the transfer and dissemination of S&T results is the key link in using S&T progress to accelerate national economic development and the ultimate demonstration of the economic results of scientific research. For many years, the dissemination and application rate of China's S&T results has been far behind that of West Germany, France, Japan, and the United States. The reasons are diverse, but it is directly related to the drawbacks caused by failing to pay attention to the mechanism of the development of the commodity economy.

The commercialization of S&T results is the breakthrough of the structural reform of research institutes (especially those specialized in applied research and development research). It has easily resolved the long-standing problem of the divorce of the selection of research projects and the dissemination of research results from production. Through technological

markets, S&T results have been commercialized, various forms of technological trade activities and multifarious organizations dealing with disembodied commodities have appeared, a multi-level technological trade network has formed, the relations of technological associations have been strengthened, the circulation of S&T personnel has been promoted, and new technology and knowledge industries have been developed. At present, the exchange of technological commodities has been developed to a certain degree in China, but in general, it is still in the initial stage. We should relax the management policy of technological market, advocate diversified forms of exchange, extensively carry out such practices as the transfer of research results, technological contracts, the public bidding of difficult research projects, technological consultation, technological service, and information exchange, and support research institutes in engaging in the joint management with enterprises by exchanging their intelligence and technological results for shares.

2. Develop the Managerial Function of Research Institutes and Increase the Economic and Social Results of Scientific Research

According to the process of management, the function of scientific research management can be divided roughly into several areas: planning, organization, coordination, and control. It is demonstrated mainly in the management of the scientific research process. However, the problem usually is that we emphasize process while ignoring target and pay attention to input while ignoring output. Although some research institutes have various experiences in a certain field of the management of process, the success rate of their research projects is not very high and not many of their research results can yield great economic results and be popularized and applied. This phenomenon is more common with those research projects which are selected by research institutes themselves and have nothing to do with the needs of society. This problem is worse when research institutes are under the "supply system" and eating form the "same big pot."

In the future, as the "double-track sytem" of research funds is implemented, the function of scientific research management is bound to be transferred from process management to target management. Before a research project is determined, we must carry out two investigations: 1) the investigation of social demands; and 2) the investigation of the trend of S&T development at home and abroad. The former is to quickly understand the needs of state, provincial, municipal, and regional economic construction so as to determine research projects. The latter is to keep abreast of the trends and developments of given industries and disciplines so as to solve problems concerning the academic significance, technological line, and technical and economic targets and levels of a selected project. The selection of a research project and its goal should be based on the intersection of the two investigations. As for technological development items and projects, a compensation contract may be signed through the public bidding system under which, the consigner will provide funds and conditions and the research institute or project research group will provide practical S&T results according to the specified goal and time limit. With regard to that basic

research and exploratory applied research which are supported by scientific funds, we can also exercise target management. The only difference is that we should give more freedom and allow failure in the process of research.

In the past, the task of research institutes was summarized as producing research results and talented people, which is one-sided. If we simply emphasize the production of research results and talented people, we would pay no attention to economic and social results. If we fail to stress the dissemination of research results, we will not be able to transfer large amounts of science and technology into productive forces or even cause scientific research to be separated from production. Therefore, scientific research work must implement in an all-around way the principle of serving economic construction, be geared to the economy and society, and pay attention to economic and social results so as to attain the goal of producing more research results, talented people, and economic results. Because of this, when we draw up scientific research projects, we must consider five combinations. In other words, scientific research projects should be combined with state economic construction, scientific research results with dissemination, cost of production of scientific research with economic and social results, product development and research with market demands, and short-term goals with intermediate- and long-term development orientation.

3. Readjust the Organizational Structure of Research Institutes, Establish Horizontal Links, and Fully Develop the Dynamic Role of Research Institute in Serving Production

The structure of existing research institutes in China is basically the closed, rigid structure of an entity. For instance, research institutes and departments all have a fixed number of staff, S&T personnel work for one unit for dozens of years and cannot get a transfer, the pattern of structure is unitary, and their ability to handle emergency situations is weak. The characteristic of modern S&T development is that more and more work involves multiple disciplines and specialties and that the number of research activities carried out between different research institutes and deparments increases as each day goes by. The traditional, closed, and rigid structure can no longer meet the needs. It is necessary to establish, through the structural reform of research institutes, an open, interconnected, and flexible structure. The structure can be both rigid and flexible. Personnel can be transferred and reorganized freely and flexibly. The pattern of structure may be diversified. They can be state-owned, collectively-owned, individually-owned, or cooperative. They can be on different scales, have different priorities and characteristics, and engage in different levels of research, development and dissemination work. Research institutes should, in accordance with the principle of voluntary participation and mutual benefits, break through barriers between different regions and departments, establish various forms of technological associations with enterprises and industries, and form a long-term stable relationship of technological cooperation. It is suitable for some research institutes to establish industrial technology development center. Some need to consider enterprises as their intermediate test workshops or trial-production plants. Some may be built into new technology joint development companies and the integrated bodies of scientific research and production so that they can carry out creative research

activities for the development of high technology products and new technology industries. We should, through the practice of scientific research, experiments, and production, establish scientific research institutes that suit China's national conditions, are rigid and flexible and are full of vitality.

4. Respect Knowledge and Talents and Fully Arouse the Enthusiasm of S&T Personnel

The fundamental aim of the structural reform of research institutes is to liberate productive forces. The most pressing task at present is to fully utilized existing S&T personnel and enable them to make maximum contributions to economic construction and S&T undertakings.

Shortly after the 3d Plenum of the 12th CPC Central Committee, leading comrades of the central government clearly pointed out that the most important thing in the restructuring of the economy is to respect knowledge and talented people. This is more so in the S&T structure. There is definitely no hope for a country or a nation if it does not respect knowledge and talented people. A research institute would not be able to come up with any achievements or reassure people if it fails to respect knowledge and talents. The key to the prosperity of business lies in the use of people. This is so at all times and in all countries without exception. If information is considered resource, then talented people should be considered capital. Leaders should have the "heart to love talents, eyes to know talents, means to use talents, broad mind to accept talents, and duty to train talents," and create a good environment to bring forth large numbers of talents and make the best use of everybody's talents.

The structural reform of research institutes must trust and rely on the broad masses of S&T personnel. Working on the first line of scientific research for a long time, they have the richest practical experience, the deepest understanding of the defects in the old system of research institutes, the strongest desire to demand reform, and the most right to speak about what and how to reform. They are the main force of the structural reform of research institutes. As long as leaders listen attentively to their voices, respect their opinions, and support them in boldly exploring the structural reform, S&T personnel would, out of the sense of high responsibility to the party, the people, and S&T undertakings, volunteer to suggest ways and means and devote their energies to the structural reform of research institutes.

The experience of success in the reform of economic structure has told us that the key to enlivening the economy is to separate ownership and management right and fully invigorate the most basic economic organization of rural and urban economic structures--households and enterprises. The restructuring of the economy has given the structural reform of research institutes a great enlightenment. Invigorating scientific research also depends on stimulating the vitality of research institutes. As a scientific research unit, not only must a research institute manage scientific research activities according to the law of scientific research, but it must also carry out administration and management according to economic law, use economic and social results as the basis to coordinate responsibility, rights, and interests and unify the

efforts to produce research results, talented people, and economic results, and fully develop the enthusiasm and creativity of research institutes and S&T personnel. This is the fundamental aim of the structural reform of research institutes.

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FUTURE OF TECHNOLOGICAL DEVELOPMENT INSTITUTES DISCUSSED

Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 4, Oct 86 pp 36-38

[Article by Zhang Yu [1728 3558] and Liu Linquan [0491 2651 3123] of the Sichuan Institute of Finance and Economics: "Technological Development-type Scientific Research Units Have a Promising Future; About the Investigation of the Chengdu City Electronics Research Institute"]

[Text] The characteristic of technological development-type scientific research units is that they gear technology directly to the economy and use scientific research results in production. With the in-depth development of the reform of the S&T system, this kind of scientific research units will gradually implement the technological contract system, earn income through a variety of effective services, accumulate funds, and become independent economically. How do various technological development-type scientific research units adapt to this new situation and display their talents in the modernization drive is a common and realistic issue. The Chengdu City Electronics Research Institute of Sichuan Province has offered beneficial enlightenment in this regard.

The Chengdu Electronics Research Institute was founded in 1978. It is a small to medium-sized research institute. It now has 157 staff members and workers. From 1980 to 1985, its net income increased from 58,000 yuan to 800,000 yuan; its per capita net income from 716 yuan to 5,095 yuan. The number of scientific research projects it has completed increased year after year. In the past few years, it has completed over 70 projects on scientific research, trial-production, popularization, and application, of which, 3 won the fine new product awards of the State Economic Commission and 8 won major provincial and city S&T achievements awards. According to incomplete statistics, by the end of 1985, the development research results of this institute were applied in over 20 provinces and municipalities across the country. They involved many fields such as machine-building, metallurgy, national defense, and chemical industry and created up to 10 million yuan of cumulative social and economic results, with is more than tenfold the original investment of the institute. Their main experiences of achieving success on the road of closely combining scientific research and production are as follows:

1. Choose a Correct Orientation and Gear Scientific Research to Production

Choosing a scientific orientation according to market studies, the needs of economic construction and their abilities is the primary link for medium-sized and small scientific research institutes to seek survival in development and application. In view of the characteristics of limited technological forces and insufficient financial resources, the Chengdu Electronics Research Institute did not concentrate on tackling major problems in computer research and development. Instead, it carried out various kinds of work in close connection to the popularization and application of computers. In practical work, they were closely involved with grassroots units, attached great importance to market research and forecast, and persisted in choosing those projects, which are urgently needed in economic construction and can yield quick results, as the focus of popularization and application. By doing so they reached the point where scientific research and production are combined. In recent years, Sichuan Province has had an energy shortage, where electricity was available for 4 days and cut off for 3 days during emergencies, causing serious effects on economic results. They understand that this situation cannot be fundamentally reversed in a short period of time and that energy-saving technology will have a broad market for a long time to come. Because of this, they adopted a principle for the selection of scientific research projects that is centered on energy conservation and aimed at improving economic results, vigorously developed energy-saving technology, and popularized the application of microcomputers.

In the past few years, due to its correct service orientation, this institute has had a steady flow of research projects and continued to invigorate research work and broaden the scope of energy conservation which now extensively involve the conservation of electricity, gas, coal, oil, and water. It has completed over 40 microcomputer application projects concerning energy development and conservation and used all of them in the practice of production. The development and application of these scientific research projects have not only widened the road for the institute but, more importantly, helped alleviate the urgent need of economic construction and improved the economic results of user departments.

For instance, in 1983, after the "microcomputer-aided steel type analysis system," which was developed for the No 1 subsidiary plant of the Changcheng Steel plant, was put into operation, electricity consumed for making each ton of steel was reduced by 28 kwh, and each year, this plant could save about 2.24 million kwh of electricty, over 170,000 yuan in value, equivalent to threefold of the investment in the system. At the same time, the plant also reduced the waste of steel and improved the quality of products.

For another instance, the synthetic ammonia first-stage converter-control system, which was developed by this institute in 1985 for the Honghe Chemical Plant, may save over 140,000 yuan of steam and natural gas each year, and it takes only 3 months to recover the investment in the system.

2. Customer is number 1 and Exploration of Technology Market

Since the commercialization of technology, using high-quality service to get customers and gain a market is an effective way for development research institutes to seek growth in competition. In 1982, the competition on the technology market of microcomputer popularization and application became acute as soon as "microcomputer fever" appeared in the nation. In order to be in an invincible position, the Chengdu Electronics Research Institute adopted "customer is number 1" as the business strategy of its technology market.

First, guarantee quality and gain the trust of customers. In a microcomputer application project, users' biggest headache is caused by the poor stability and reliability of the system. In view of this, the institute first concentrates on studying the reliability and stability of the system in regard to the demonstration and design of the plan and the selection of the main engine, external accessories, and components. In the process of manufacturing, each and every spare part and interface is screened carefully to make sure that no product which fails to meet customers' technological requirements is allowed to get out of the institute, thereby greatly raising the reputation of the institute.

Since the "microcomputer-controlled natural gas flow measuring device," which was developed in 1983 by the institute for the Luzhou Natural Gas and Chemical Plant of Sichuan Province, was put into operation, not only has it reduced waste by 1 to 2 million yuan each year, but its operation has been stable and reliable. It is very popular among users and its application has already been extended to many plants. All of the 15 complete systems provided by the institute in 1985 were up to quality standards and two of them respectively won the first-prize fine software award of the Sichuan Provincial S&T Commission and the computer application achievement award of the Sichuan Provincial Electronics Department. The business strategy of using quality to achieve success of this institute has not only stabilized old customers but also won over large numbers of new customers.

Second, after-sale service and problem shooting. After they complete a project, in order to satisfy customer's demand to the maximum degree, in addition to providing customers with necessary data, they take time out to arrange lectures for customers, train operators and maintenance crew and help customers master the whole set of technologies as soon as possible. In 1984 alone, they sponsored three classes on IBM-PC compatibles, and as many as 500 people attended. Moreover, they also sent out technological backbones to keep abreast of situations across the country. For instance, the users of the microcomputer light pen image analysis system, which was developed by this institute, can be found all over the country. In 1984, they sent out over 20 people to provide service at 16 units of 9 provinces and municipalities. By the end of 1985, technological expansion services provided by this institute amounted to a total of 1 million yuan. This practice has not only solved technological problems for customers but helped the institute understand customers' new demands on microcomputer systems. In addition, they have also vigorously opened up windows and founded the DIANZI BAO (ELECTRONICS JOURNAL), DIANZI WENZHAI (ELECTRONICS DIGEST), and RUANJIAN BAO (SOFTWARE JOURNAL), to serve the broad masses of users.

Third, think about customers instead of taking advantage of them. During the whole process of research of a project, this institute always gives careful consideration to users' interests and strives to reduce the cost of production under the condition that technical targets and reliability are guaranteed. When they sign contracts, their charges are reasonable. With regard to those projects which can yield good social and economic results, they will cooperate enthusiastically even if users are short of funds for the time being. For instance, the thermal efficiency computer project, which was takened up by the institute for the Chengdu Thermoelectric Power Plant, needed 20,000 yuan alone for the cost of development. Considering the fact that the user had financial difficulties, the institute collected only 10,000 yuan from the power plant for the time being and paid some of the expenses with its own funds. As a result, this development task was accomplished satisfactorily. This business style of thinking about customers all the time has won favorable remarks from the broad masses of users and, at the same time, further enabled users to cooperate with the institute enthusiastically, thereby stabilizing the market. The tenet of the broad masses of staff members and workers in this institute is that socialist research institutes should not practice what capitalists do--trying to cheat or outwit one another.

3. Cooperating With Units in the Interior and Importing From Abroad To Speed Up Technological Development

Applying a new technology to production often is an inter-trade and inter-department, comprehensive task. Following the road of integration is the key to marching toward development of technology in depth and breadth and application of medium-sized and small research institutes.

In the past few years, the Chengdu City Electronics Research Institute has achieved marked results by cooperating closely with the departments concerned in economic and technological affairs under the principle of equality and mutual benefits. They have developed their own strong points and worked together to tackle major problems. This institute has cooperated with many units including the Guilin Software Company, the Shenzhen Electronics Institute, and the Chengdu Telecommunications Engineering College, in developing a number of microcomputer application projects that are highly technical and involve a tremendous amount of work, thereby satisfying users' needs in various trades and professions. To carry out technological development by relying on integration, this institute mainly adopts the following three forms: 1) Develop jointly with other plants and sicentific research institutes. For instance, through cooperation with the Chengdu Measuring and Cutting Tools Plant and the Chengdu Tools Research Institute under the Ministry of Machine-building Industry, the Chengdu City Electronics Research Institute used microcomputers to improve the circular pitch measuring device produced by the abovementioned plant. As a result, the precision of the product reached the advanced level at home, and the product won the fine new product award of the State Economic Commission. 2) Develop jointly with scientific research organs. For instance, this institute cooperated with the No 8 design institute of the Ministry of Chemical Industry in using microcomputers to carry out the technological transformation of eight enterprises including the Mianyang Natural Gas and Chemical Plant with the No

8 design institute responsible for engineering design and providing supplementary equipment and the Chengdu Electronics Research Institute responsible for application research and design, installation, and testing. By doing so, each has developed its own advantages, thereby ensuring that the transformation work is advanced and economical. 3) Advance toward the world and cooperate with foreign investors in the development of new technology. In 1985, this institute reached an agreement with Hong Kong's Dahua Company on cooperating wholeheartedly in the application of highly difficult electronic technology; it also reached an agreement with Japan's Toyo Trading Co. Ltd. on preparing to transfer from cooperation to joint investment for joint development of software to help the software products of this institute enter the international market.

4. Sign Project Contracts and Reform Internal Management

Since S&T personnel are the explorers of new productive forces, arousing their enthusiasm is reliable insurance for the quick transformation of science and technology into productive forces. Since 1983, the Chengdu City Electronics Research Institute has implemented the scientific research economic responsibility system based on "project contracts" under which research groups are organized according to projects and group leaders are elected democratically. A project research group and the research institute will sign a "contract on a specific project" including terms on the content of development, technical targets, date of completion, expenses, and net income and stipulations on rewards and penalties. At the same time, the comprehensive reward has been abolished throughout the institute and a direct link has been established between bonuses and the performance and economic results of every staff member and worker. The practice over the past 3 years has proved that the responsibility system of "project contract" has increased the vitality of the institute, enhanced the sense of responsibility of research personnel to their work, and shortened the cycle of technological development. Since 1983, the cycle of technological projects from development to application has been reduced substantially. For instance, a microcomputer application project developed by this institute for a chemical plant was completed in half of the scheduled time. In addition, after project contracts were implemented, project research groups began to practice independent accounting and changed their previous practices of ignoring production costs and wasting money, resulting in an anuual increase of about 20 percent in the use of raw materials and an reduction of about 15 percent in engineering project production costs.

12302
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CONSTRUCTION OF SCIENTIFIC, INDUSTRIAL PARKS DISCUSSED

Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 4, Oct 86 pp 11-14

[Article by Zhang Jinquan [1728 6855 0356] of the Chengdu City Scientific and Technological Information Research Institute: "A Preliminary Probe of Several Questions Concerning the Construction of Scientific and Industrial Park District"]

[Text] Along with the rising wave of the new technological revolution, high technology park districts, which play a central role, have sprung up in large numbers in many countries and areas. Currently, some cities in China are also carrying out research and experiments on the construction of "special scientific and technological zones." Exploring the issue of the construction of scientific and industrial parks in China at a time like this is of great immediate significance. This article will discuss a preliminary understanding of issues concerning the purpose, functions, conditions, and principles for the selection of projects, the methods of development, and policies of the construction of scientific and industrial parks in China.

1. The Purpose and Requirement of the Construction of Scientific and Industrial Parks

Scientific and industrial parks are the product of a certain stage of S&T and national economic development. With new technological communities emerging, developed countries or developing countries which have realized fast economic growth, in order to meet the needs of the change and development of science and technology, production structure, and product mix, have attached great importance to the development of new technology in addition to the efforts to stress technological progress and strive to gain the initiative on the part of enterprises. One of the main measures for the development of new technology is to build various forms and sizes of high-tech scientific research parks around the goal of continuing to increase the motive forces of economic development. Although different countries use different terms--the United States usually refers to it as building "research and industrial complexes," Japan calls it "science city" or "technology city," and West Germany says building "science parks"--their basic characteristics are the same, namely intensive intelligence, knowledge, and technology. In traditional economic zoning, production arrangement is carried out around the development of

natural resources and processing whereas in scientific and industrial parks, efforts should be made to carry out new industrial distribution around the "secondary resources" consisting of intelligence, knowledge, and technology. An important characteristic of today's S&T development is that the tendency toward comprehensiveness and completeness is getting stronger and stronger. For instance, scientific theories tend to be unified, technological development tends to be comprehensive, science and technology are close to each other, and natural and social sciences are linked together. This development trend urgently needs the organic and high-level integration of scientific research, teaching, designing, and production departments. In the construction of scientific and industrial park district, it is necessary to fully embody the characteristics of the development of modern science so that scientific and industrial parks can have the advantage of the comprehensiveness of modern science and technology that have multiple disciplines and departments; adopt the ability and system to innovate, develop, import, absorb, transfer, and spread modern advanced technology and new technology; develop basic industries, technologies and research in coordination with new science and technology; and establish an advanced and rational modern S&T system and structure. In sum, the most basic requirement for the construction of scientific and industrial parks is to closely combine science, technology, and industry, and the purpose of doing so is to accelerate the development of new industrial technologies, newly-emerged industrial communities, and the national and local economies.

2. The Main Functions of Scientific and Industrial Parks

The main task of the construction of scientific and industrial parks is to build new technology development zones and sources of knowledge- and technology-intensive industries and products so as to effectively accelerate the development and change of China's production structure and product mix and gradually suit the needs of today's increasingly acute market competition and future development. It will play a role of many aspects in economic and social development.

A. It plays the role as the window of technology, knowledge, management, and policy. Building scientific and industrial parks can help the continual absorption of the latest information in the development process of the new world technological revolution, the continual importation, absorption, and assimilation of advanced science and technology, advanced management knowhow, and advanced policy ideas, and the implementation of innovation in light of China's reality; and it can also help narrow the gap between us and the world's advanced S&T level as soon as possible.

B. It is the research and experiment base of new science and technology. After a series of S&T research and development, scientific and industrial parks, based on the development of new technology and industry, may provide a continuous supply of technology-intensive new products, establish corresponding new industries, and by doing so it can transform traditional industries and help accelerate the founding and development of technology-intensive industries and promote the readjustment and change of production structure, product mix, and technological structure.

C. It is the cradle of the training of modern S&T personnel. Aiming at studying and developing the latest science and technology, closely combining teaching, scientific research, and production, and centralizing a massive amount of S&T and economic information not only can help develop the potential of existing personnel and turn knowledge into technology and technology into wealth but also can help S&T personnel master advanced science and technology and develop it quickly. It also can help reform the undertakings of higher education and bring up a large number of high-level S&T personnel who are geared to the needs of the present, the world and the future.

D. It may be used as an experimental base for the reform of the S&T system and the consolidation of horizontal links. The scientific and industrial park has new science and technology and social and economic relations in all fields. At the same time, it also has a relatively independent scope, boundary, and condition, greater decision-making power, less restriction of traditional systems, fewer levels of reform, quick feedback, and great flexibility. Therefore, if the scientific and industrial park is built to be used as an experimental base for the reform of S&T system and the development of horizontal links, accumulating and comparing experiences will be easier.

3. The Selection of Specialized Trades and Areas for Scientific and Industrial Parks

S&T development requires a good environment; therefore, while selecting specialized trades and geographical location for the construction of scientific and industrial parks, attention should be paid to the availability of certain conditions:

A. Superior specialized trades which are planned to be developed. There should be a relatively good foundation and outstanding specialities in regard to the rank of talented personnel, basic research, resource conditions, and the ability to form industries within the scope of these specialized trades.

B. Relatively concentrated S&T forces. There should be a definite number of them, and their basic, applied, and development research forces should be able to complement and coordinate with each other.

C. A relatively complete variety of disciplines. There should be specialized trades concerning natural sciences, humane studies, social sciences, and interdisciplinary sciences so as to make it easier for various disciplines to permeate each other, conduct comprehensive studies, and establish and carry out the system of large-scale cooperation.

D. Abundant books, information, and reference materials, extensive sources of information, and a definite foundation for the network of S&T and economic information.

E. Relatively concentrated large precision instrument and equipment and good experimental and testing conditions.

F. A foundation for international contacts and relations, the characteristic of opening to foreign countries and other parts of China, and the ability to

utilize foreign and domestic investment, technology, equipment, and competent personnel.

G. A sizable technological reserve, an industrial basis, a group of intellectual- and technology-intensive enterprises, the ability to assimilate, absorb, spread, and transfer advanced technology, and the ability to use new technology in production.

H. A good communications system, wide hinterland, complete infrastructure, and superior investment environment.

4. The Orientation of the Technological Development and the Principle of the Project Selection of Scientific and Industrial Park

To achieve good results in the technological development of scientific and industrial park, it is necessary to pay attention to the following points:

A. Strengthen the research and application of basic technologies. Instead of basic sciences, the so-called basic technologies refer to the basic technologies of new industries which are linked to production, have originality and have great potential, can branch out and become many new industries, and can bring about relatively great changes in production structure.

B. Combine the development of new technology and the transformation of traditional industries. Traditional industries are the basis of the national economy and the main force for realizing the goal of quadrupling production. For a fairly long time to come, traditional industries will still be the principal part of the national economy as well as the market and support of new technology and industry. Speeding up the technological progress of traditional industries is the main task of invigorating the economy and developing new technology.

C. Combine long-term and short-term projects with emphasis on the latter and attach great importance to economic results when selecting the targets of new technological development. First, we should choose those projects which have conditions for application and can yield marked economic or social results in application. We should give priority to the development, production, popularization, and application of such projects and strive to live up to the goal of developing new industries by relying on their own capital accumulation. At the same time, we should also pay sufficient attention to the research of those new technologies which can yield economic results in the intermediate or long run, but not in the short run so as to provide an appropriate technological reserve, increase the ability of continuous development, and give national economic developement both initiative and continous support.

D. Adopt the principle of setting limited goals, highlighting key points, stressing strong points, avoiding weaknesses, and developing advantages, select targets precisely, concentrate forces, and complete several tasks before others. The selection of projects should genuinely embody the location and characteristics of the given area, be conducive to developing the S&T

advantage and specialities of this area, fully utilize existing scientific research basis, industrial basis, and resource conditions, and help improve environment and overcome the restrictions of energy, communications, and transportation.

E. Break through regional barriers, integrate units inside and outside the district, and combine research and imports. It is necessary to develop our own characteristic and creativity on the basis of fully utilizing the treasure house of world's S&T achievements and mastering, assimilating, and absorbing all applicable technologies.

5. The Method of Technological Development

Technological development requires unified planning, division of labor, cooperation, and continuous development from lower to higher levels. Concrete organizational forms, methods, and means may vary according to different circumstances.

A. Single-item project may be developed independently by a scientific research unit, an institution of higher education, or a designing unit which has a relatively good foundation and is specialized in the same field.

B. With regard to comprehensive tasks or large-scale development projects involving several disciplines and specialities, many units should join efforts to carry out joint development and share work and responsibility, and it is necessary to strengthen unified planning and coordination. We should ensure that when working alone, each unit should have a specialty to help bring into play its technological advantage and that when working together, they should form a coordinated process to help the overall project progress according to the plan and bring into play the comprehensive technological advantage of their integration. They should use a unified plan and agreement to coordinate research work among them.

C. With regard to the fields of greater difficulty which require specialists of many disciplines to work closely together to carry out continuous development, we may organize flexible scientific research organizations to tackle key problems. Such organizations have great flexibility and maneuverability. They are different kinds of research groups or centers formed to coordinate efforts to tackle key problems by the outstanding scientific research and designing personnel of relevant universities and scientific research and designing units in accordance with the actual needs of tasks focusing on major development areas. The size of the staff may be adjusted whenever necessary according to the needs of the task, and the work as a whole should be carried out in a unified manner according to the plan and relevant economic laws.

D. With regard to the development of those engineering projects whose technology is relatively mature and which may form new industries, concerned scientific research units (or universities), designing units, and enterprises may form "a chain" of development organizations, and the leading link of this chain may be scientific research unit (or university), designing unit, or production unit according to the stage of the task and the shift of the work

focus. These units will do a technological relay until the final product is developed.

E. With regard to major engineering projects, we should exercise centralized leadership and unified management, assign responsibility to different levels, coordinate in a timely manner, and manage with modern scientific management methods such as "plan evaluation method," "key line method," and "system analysis and management method." In addition, we should establish strong and powerful functional organs to take charge of inspection, coordination, and management work.

6. The Adoption of Preferential and Support Policies for Scientific and Industrial Parks

In order to develop selected new technology effectively, it is necessary to adopt some preferential and support policies for the development of new technology and industries:

A. Give preferential treatment to all development projects and new products, which are geared to the orientation of the development of scientific and industrial park district, in regard to taxes, credit, and depreciation.

B. Give greater decision-making power to those economic entities which develop new technology and new industry. Some reward measures favorable to the development of new technology and new industry may be formulated, and their bonuses may be excluded from the total amount of bonuses, exempted from bonus tax, and paid in cash.

C. Give priority to financial and material support provided by means of credit, rent, and lease to the development projects of scientific and industrial park.

D. Mobilize social funds to serve as an important financial support for the construction of scientific and industrial parks by applying for the issuance of stocks and bonds.

E. Give preferential treatment in planning and construction to scientific and industrial parks to make it convenient for the infrastructure construction of new technology and new industry and help attract foreign and domestic funds and technology.

F. Allow the reasonable flow of talented personnel in scientific and industrial parks and let them hold two or more posts concurrently in different units and cooperate with each other in scientific research.

G. Carry out unified construction of living and service facilities in scientific and industrial parks according to the urban construction plan and encourage the development of the tertiary industry.

H. Give priority and preferential treatment to horizontal technology transfer within scientific and industrial parks and encourage the expansion of affected areas.

I. Strengthen S&T information exchanges at home and abroad, collect in a timely manner and exchange domestic and foreign books, magazines, periodicals, bulletins, special reports, commercial publications, inspection reports, and internal data, publish specialized and popular scientific publications and communications bulletins, and promptly reflect the trends of S&T, industrial and market development in the given field of technology so as to quickly absorb domestic and foreign advanced technology, formulate corresponding countermeasures, and seize the opportune moment to develop new technology and new industry.

12302
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NATIONAL DEVELOPMENTS

COORDINATION OF SCIENCE EFFORTS IN BEIJING DISCUSSED

Beijing BEIJING RIBAO in Chinese 15 Sep 86 p 1

[Text] The third congress of the Beijing Municipal Science and Technology Association has successfully closed and we ardently congratulate this session on its attainment of satisfactory successes.

It has been 6 years since the "second congress" of the municipal science and technology association was held in June 1980. In those 6 years, science and technology circles in the capital have been like other battlefronts, where tremendous changes have occurred and great achievements have been made. One prominent problem at present is that not enough has been made of the advantages of science and technology in the capital. On the occasion of this "third congress" of the municipal science and technology association, attention was centered on the discussion of this problem, and we have the greatest confidence that this will vigorously promote the exploitation of the advantages for science and technology in the capital.

In comparison with fellow provincial level cities, the greatest advantage for this city is its galaxy of talent and its abundant intellectual resources. There are 562 science research units within the Beijing region and more than 70 higher institutions; there are more than 100,000 scientists and technicians, which is 18.4 percent of the total number of scientists and technicians in this country, and among them the central units and higher institutions have gathered a large group of highly qualified specialists. Many fellow provincial cities are actively using this advantage for the capital, while many departments and units in this city, and especially a certain portion of medium to large enterprises, have yet to do so, and some units are even unwilling to deliver up technical achievements. According to the statistics of a technical service department, of technical achievements the rights to which were transferred in the first half of this year, 50 percent were purchased by the two provinces of Jiangsu and Guangdong, while enterprises in this city bought only 5 percent. This situation in which "we starve while guarding the hotcakes" must change. Our leaders at all levels, as well as units from all professions, enterprises, and facilities should treat the exploitation of science and technology advantages in the capital as a problem of strategy, for if we are to work out the particular plans and measures by which each profession and unit exploits the advantages of science and technology in the capital, this will truly shift the development of

economic construction and of each undertaking onto the right track of relying upon the advance of science and technology.

To make the most of advantages for science and technology in the capital, we should maintain the restructuring, break up the creation of barriers, and through various ways should vigorously promote lateral associations between science research and teaching units on the one hand and production enterprises on the other. Currently, there are 428 organizations throughout the city that are science research and production associations. By relying upon the solid scientific and technical strength of the central science research units and higher institutions, some associations have formed strongly competitive production capacities. However, in general there are not enough research and production associations in this city, and there is still a gap when compared with fellow provincial cities. We want to keep in step with the reform of the economic system and the restructuring of the science and technology system and soundly promote the association of science research units with production enterprises. The leadership of some medium to large enterprises should overcome the concept of themselves as self-sufficient and change their tendency to rely only upon their own power to carry out closed forms of technology development. They should see that science research units, and especially the central research units, have many highly qualified specialists, and that they can sincerely depend upon them, to which end they should initiate efforts to create various types of associations.

If we are to make the most of the advantages for science and technology in the capital, we should earnestly make the most of each society within the municipal science and technology association. The scientific and technical strength of the capital includes the five great armies of the Chinese Academy of Sciences, the Commission of National Defense Science, Technology, and Industry, various ministry commissions within the central government, higher institutions, and local scientific and technical strength. But to bring these five armies together there is only the Beijing Municipality Science Association and its societies. At present, 126 city level societies and institutes have been developed. Each society is complete in disciplines and specialties, and each has a group of well known, highly qualified specialists. In recent years, the municipal science association and its societies have done quite a bit of organizing in regard to exploiting the advantages for science and technology in the capital, have served as nodes, and have gained much experience. From now on we hope that the municipal science association and each of its societies will continue to make the most of this initiative and creativity, while at the same time we hope that leadership at all levels and production enterprises should thoroughly understand the enormous function and capacity of the science association and its societies, and actively seek their aid. Only by joint efforts in these two areas will we link up the numerous production enterprises with the capital's five science and technology armies as quickly as possible, forming thereby tremendous power with which to promote the even faster forward development of economic construction and of each cause.

12586
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SHANGHAI DEVELOPMENT PLANS NOTED

Shanghai WEN HUI BAO in Chinese 8 Sep 86 p 1

[Report by Yao Shihuang [1202 6108 3552]: "Shanghai Determines Major Development of Four New Technologies"]

[Text] Shanghai Municipality has recently decided on the major development of microelectronics and the four new technologies of computers, biologic technology, fiber optic communications, and new materials, and lasers and robots have also been included within the plans for development. The development of new technologies in Shanghai will be combined with the technological transformation of traditional industries, which will gradually form a rising new industry.

There is already a basis for the area of developing large scale integrated circuits when progress was made in exploiting the function of imported equipment and the 2nd department of the Shanghai Metallurgy Institute of the Chinese Academy of Sciences was made into a product design center and LSI testing base. In particular, the specialized circuits urgently needed by color television, electronic clocks, and communications equipment will gradually go into batch production to reduce imports and realize nationalization. To closely integrate science research with production, two associations will be formed from the Shanghai Metallurgy Institute of the Chinese Academy of Sciences combining with the Shangwu Factory No 14 and from the combination of the Yuanjian factory No 5, the Shangwu Factory No 19, and the Shanghai Semiconductor Institute, which will constitute the Changjiang bloc of integrated circuits associations.

In the area of biotechnologies research, there primarily will be attention paid to intermediate testing of this link, with major construction during the period of the Seventh 5-Year Plan of four intermediate testing bases, namely, the Chinese Academy of Sciences biologic engineering intermediate testing base, the Shanghai Applied Microbiology Laboratory base headed by the Shanghai Industrial Institute of Microbiology, the Biochemical Engineering Development Center headed by the Shanghai Institute of Agricultural Chemicals, and the Biologic Reactor Intermediate Testing base headed by the Huadong Institute of Chemical Engineering. Applied research in biologic technology will focus on the areas of foodstuffs, pharmaceuticals, light industry, and industrial chemicals.

Developing fiber optic communications is the basic way to resolve the backwardness of Shanghai communications facilities. At present, Shanghai is in the process of forming a production capacity to generate more than 20,000 km of optic fiber. Practical applications for optic fibers also depend upon the domestic level of anticipation. City telephone will lay a 22.5 km fiber optic telephone circuit from the Yunnan Road telephone substation to the Wusong telephone substation. Urban telephone circuits will be gradually changed to optic fiber.

This city is also currently actively arranging for research and development of the new technologies of new materials, lasers, and robotics.

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SHANGHAI SPACE TECHNOLOGY ACHIEVEMENTS NOTED

Shanghai WEN HUI BAO in Chinese 10 Sep 86 p 1

[Report by Qian Weihua [6929 4850 5478] and Zhang Debao [1728 1795 1405]: "Shanghai Participates in the Development and Launch of Nine Satellites"]

[Text] Shanghai already has the technical capacity and various conditions needed for developing rockets and satellites, for among the 18 satellites launched since the founding of this nation, 9 of them have been designed, built, and launched with the participation of Shanghai, which indicates that Shanghai has already become one of the research and production bases for strategic weapons and space technology. This was revealed to reporters the other day by the director of the Shanghai Office of Spaceflight, Su Shikun [5685 0013 1024].

The Shanghai Office of Spaceflight is an important force in the spaceflight industry of this country. In the early 1970's, in the name of the Central Committee, Premier Zhou Enlai approved the handing over of the mission to develop and launch this country's large earth satellites to the Shanghai Office of Spaceflight. After this, Shanghai successfully developed carrier rockets and launched 6 satellites, and jointly developed and launched in cooperation with Beijing 3 satellites, all of which made contributions to the development of this country's spaceflight technology.

In developing space technology, the Shanghai Office of Spaceflight has fostered and trained a contingent that has a theoretical background, practical experience, and is bold in overcoming difficulties. This contingent is complete in specialties, fully technical, and has filled a domestic void in a major technology. The carrier rockets that they developed not only successfully launched satellites, but together with fellow units they used a rocket to launch three space physics exploration satellites, each of a different purpose. This consequently allowed this country to become one of the few countries in the world to have the technology to "launch multiple satellites from one rocket." The "Long March No 3" carrier rocket in the development of which they participated has successfully launched this country's first geosynchronous experimental communications satellite and practical communications and broadcast satellite.

The Shanghai Office of Spaceflight is supported by more than 300 specialty units throughout the city, among which are higher institutions and science institutes, which through joint cooperation have formed a complete space technology coordination network. They have formed unique specialties in the fields of microelectronics, infrared technology, automatic controls, communications technology, and sensor technology. Su Shikun indicated that to make the most of the advantages for Shanghai in the aspects of strategic weapons and space technology, Shanghai is prepared to take on the commissioned launching of foreign commercial satellites.

12586
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FORECAST ANALYSIS OF TIANJIN S&T CONTINGENT

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENCE OF SCIENCE AND MANAGEMENT OF S&T] in Chinese No 9, Sep 86 pp 14-17

[Article by Liu Baojing [0491 1405 5391], Tianjin municipal science commission, edited by Wan Li [5502 0500]: "Forecast Analysis of Tianjin's S&T Contingent"]

[Text] Origin of the Topic

It is often heard on the management of S&T cadres that "the principal reason for the lack of progress in our system of S&T research and production is the severe shortage of auxiliary professionals." "The S&T professions do not form a set, and we have a force which cannot be utilized. How do we create a complete set under optimum conditions?"

Some professional colleges also ask what kind of professional should be trained to meet the demands of the economy and S&T research work. These questions make the management department of S&T cadres feel the importance of making an analysis of the current situation of the S&T force in Tianjin and forecast the trends in its development. Aiming at this, we established the research group to "forecast the development of the S&T force in Tianjin and research its related policy," to study the economic development and trends of S&T contingent demand in Tianjin during the period of the Seventh 5-Year Plan and the year 2000, to forecast the variations of the contingent in the principal professional structure, education structure, capability structure, and the amount of human resources we have, to analyze the gap between demand and growth in order to organize better the Tianjin S&T contingent to give full play to their group superiority in S&T and economic work, and to provide theoretical bases to meet the needs of national economic development.

At present, the work of research has come close to the end and we are planning to call up related specialists in the near future for appraisal. The following is a report on some aspects of this work.

General Situation of the Tianjin S&T Contingent

In the period 1980-84, the number of natural science S&T personnel in Tianjin increased from 131,000 in 1980 to 196,000 in 1984. The rate of increase is 49 percent, which is higher than that of Shanghai at the same time (40.7 percent). Social science personnel increased from 48,000 to 123,000, with a rate

of growth of 156.3 percent. In the 1980-84 period, among natural science S&T personnel, advanced S&T personnel increased from 1,300 to 3,000, with a growth rate of 122 percent; mid-level S&T personnel increased from about 21,000 to 44,900, with a growth rate of 109 percent; and primary S&T personnel decreased from about 105,900 to 102,300, with a growth rate of -3.4 percent. Among them there are about 97,000 engineering technical personnel, who are 49.5 percent of the total number of the natural science S&T personnel, which is lower than the 54.3 percent in Shanghai and closer to the 49 percent in Beijing.

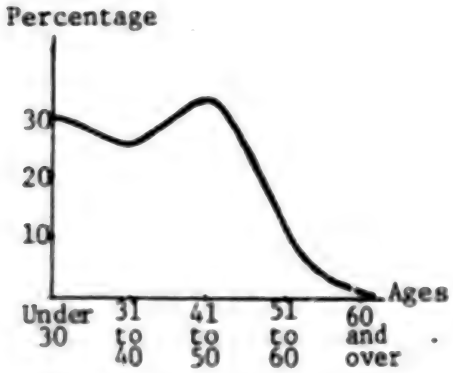

Figure 1. Natural Science S&T Age Distribution Curve, 1984

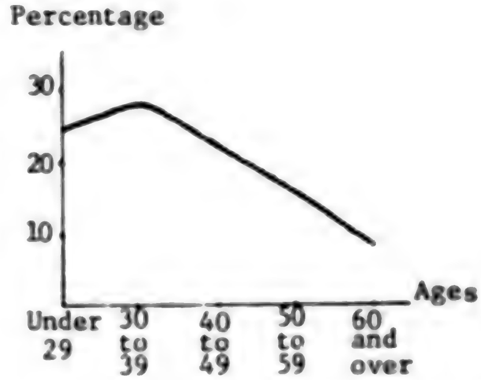

Figure 2. U.S. Scientists and Engineers Age Distribution Curve, 1978

I. Age Structure. Analyzing Figures 1 and 2, we regard the age distribution curve of U.S. S&T personnel as more reasonable and in conformity with the law of natural selection, replacing the old with the new in succession like a ladder. But in the age distribution curve of the S&T personnel in Tianjin, owing to reasons well known, ages 31-40 stand as the trough while ages 41-50 stand as the crest. We predict that around the year 2000, there will be very high losses due to natural causes and the problem of the shortage of talented people at the required levels will arise.

Now look at the age distribution curves of advanced and mid-level S&T personnel in Tianjin and PhD scientists and engineers in the United States in Figures 3 and 4: the 35-39 age band of PhD scientists and engineers in the Un[illegible] States stands as the crest while the crest of the age curve of abov[illegible] level rank S&T personnel in Tianjin stays at 46-50, and that of the high [illegible] at above 61. The number of PhD scientists and engineers in the United States of ages 30-40 is 58.4 percent of the total. The curve is smooth without sharp turns and the distribution of different age bands is also even and balanced.

From Figure 5, which shows the age distribution curve of the sampling of people in Tianjin who received national or municipal S&T awards in Tianjin since 1979, the age of receiving the award is concentrated at the ages 35-55, with the crest at age 44. Curve A in Figure 5 is a creativity curve of the 1,249 outstanding scientists in the world, drawn according to the statistics of their 1,928 items of important scientic achievements in which the crest stays around age 37. The crest age of the S&T contingent in Tianjin is 10 years older than some of the world's scientists.

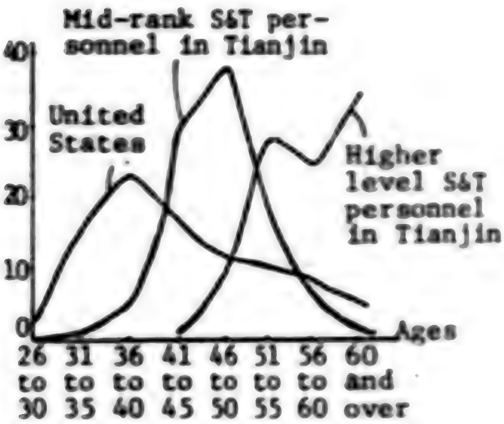

Figure 3. Age Distribution Curve of PhD Scientists and Engineers in the United States and High- and Mid-rank S&T Personnel in Tianjin

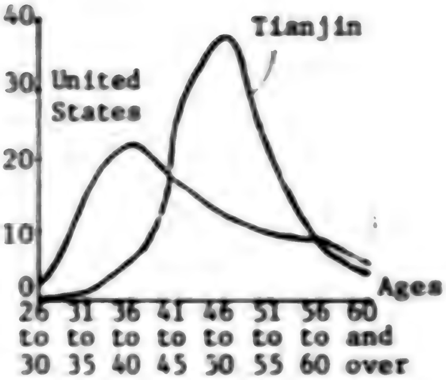

Figure 4. Distribution Curve of PhD Scientists and Engineers in the United States and Above Mid-rank S&T Personnel in Tianjin

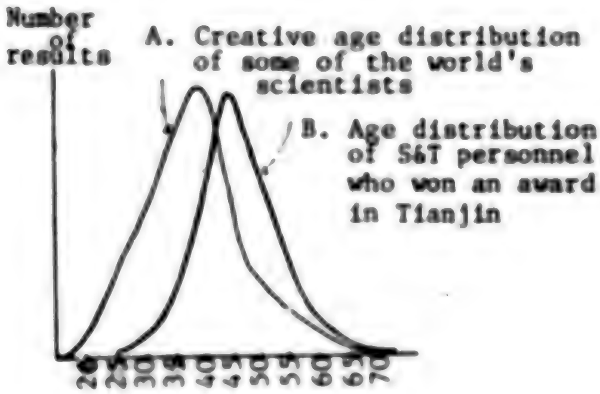

Figure 5.

II. Education Structure. Up to the end of 1984, there were about 1,400 people among the S&T personnel in Tianjin who had a degree in graduate study, which amounts to 0.4 percent of the total S&T personnel; technical school graduates number approximately 70,700, or 22.2 percent; university or college graduates number approximately 35,300, which is 11.1 percent; and high school graduates and below number 211,200, which represents 66.3 percent. Based on the 1978 statistics, among the scientists and engineers in the United States, 11.6 percent have a PhD, 28 percent have an MA, and 58 percent have a BA degree. Among the high- and mid-rank natural scientists in Tianjin, only 1.5 percent have done graduate study, with 80 PhD's, and 37 PhD equivalents which amounts to 0.24 percent. The education structure is rather weak. Table 1 shows the educational structure of the S&T personnel in the six categories in Tianjin.

Table 1. Education Structure of S&T Personnel in the Six Categories in Tianjin

Profession	Total	Graduates		College graduates		Technical school graduates		High school graduates or below	
		Persons	Percent	Persons	Percent	Persons	Percent	Persons	Percent
Mechanical engineering	16,456	17	0.1	8,472	51.48	4,330	26.31	3,637	22.10
Electronics	10,562	17	0.26	6,163	58.35	2,854	27.02	1,528	14.46
Textiles	27,173	11	0.04	11,141	41	8,174	30.08	7,847	28.88
Metallurgy	6,253	16	0.25	3,329	53.14	2,051	32.74	869	13.87
Chemical engineering, medicine	13,366	17	0.13	6,521	48.79	4,300	32.17	2,528	18.91
Construction, construction materials, urban construction	10,966	7	0.06	3,747	34.17	3,639	33.18	3,573	32.58

III. Capacity Structure. Up to the end of 1984, about 147,850 S&T personnel in Tianjin have a technical title, which amounts to 1.1 percent of total S&T personnel; 49,500 have mid-rank titles, which amount to 15.5 percent; about 168,000 have primary-rank titles, which amount to 52.8 percent; and more than 97,500 have no title, which amounts to 30.6 percent. These are lower than those in Shanghai where in 1983, personnel with a high-rank title amounted to 1.5 percent and with a mid-rank title 18.9 percent.

Superiority of S&T People in Tianjin and Current Problems

Tianjin is an important industrial base of our country, which has a long history, and is situated along the coast, with better transportation and education, and it has superiority in S&T personnel, which can be summarized as the following four characteristics:

1. It has a large number of S&T people. At the end of 1984, the number of S&T personnel in Tianjin amounted to 7.2 percent of the total number of staff and workers, which is 63 percent higher than the national specific value, and is among the best in the municipalities in the country.

2. More people in some disciplines. Among the most outstanding the number of machine-manufacturing professionals amounts to 11 percent of the total natural science contingent; electronics professionals amount to 9.1 percent; civil engineers, about 5.4 percent; chemical engineers, about 5 percent; and medical scientists, about 24.5 percent. The S&T personnel in these professions amounts to 55 percent of the natural science contingent.

Up to 1984, among the high-level natural science personnel, mechanical engineering professionals amounted to 5.8 percent of the total; electronics professionals, 3 percent; civil engineers, 8.1 percent; chemical engineers, 4.4 percent; and medical scientists, 26.4 percent, which amount to 47.7 percent of the total number of high-rank S&T personnel.

3. Personnel are superior in the fields of mechanical engineering, electronics, and chemical engineering, evidenced by an analysis of sampling of 500 national or municipal S&T achievement award winners in Tianjin since 1979 (see Table 2).

Table 2. Table of S&T Achievement Award Winners in Some Professions in Tianjin (1979-83)

Type of profession	Number of results
Mechanical engineer	117
Machine design	69
Machine processing techniques	40
Electronics	110
Instruments and meters	54
Computers and electronics	39
Radio and parts	17
Chemical engineering	102
Textiles	16
Civil engineering and architecture	11
Agriculture	21
Metallurgy	10
Medicine	22

4. Abundant number of people with knowledge of foreign languages. There are about 7,500 professionals in the field of English. Among them, 6,000 are under 40 years of age, which amounts to 81.2 percent. Those majoring in major languages such as English, Japanese, Russian, German, and French, also number about 1,000 in each language (see Table 3).

Table 3. Foreign Language Capacity of S&T Personnel in Tianjin

Language	High level	Mid-level	Elementary level
English	3,085	21,775	82,359
Japanese	668	3,559	14,390
German	150	359	1,209
French	127	324	889
Russian	720	4,556	23,442
Other		632	

The current S&T personnel problems in Tianjin are the imbalance in the age distribution of S&T personnel, the lack of academic leaders, the inappropriate proportion of designers and technical personnel, the lack of biomedical engineering personnel, the lack of basic medical research personnel, and the problem of knowledge brushup among many of the S&T personnel.

S&T Contingent and Technological Progress

Looking forward to the prospect of the Seventh 5-Year Plan in Tianjin, investment will not be on a large scale. It also faces the disadvantageous situation of price adjustment and the rise in material prices. Attaining the goal of economic growth designated by the Seventh 5-Year Plan lies mainly in walking along the road of local extended reproduction, that is, to rely on the economic growth brought by technological progress.

According to statistics from related sources, in national and collective independent industry and enterprise accounting from 1952 to 1980 in Tianjin (see Table 4), the contribution of technological progress to industrial growth is 21.34 percent, which is higher than that of the whole nation in the same period. Even with a level as high as that, it is only comparable to that of the developed countries in the fifties. According to statistics from abroad, in the developed countries, S&T growth amounts to 20 percent of the economic growth in the 1920's, 40 percent in the 1960's, and 60 percent in the 1970's, and it will increase in the 1980's.

Table 4. Technological Progress Vs Output Value in Tianjin, Calculated According to National, Collective, and Independent Industries, and Enterprises

Years	Percent of contribution to technical advancement
1952-1957	10.58
1957-1962	-54.09
1963-1965	51.99
1966-1975	25.58
1976-1978	0.57
1979-1980	44.81

Apply the Cobb-Douglas production function:

$$Y(t) = A(t) \cdot K(t)^{\varepsilon_1} \cdot L(t)^{\varepsilon_2} \cdot \mu$$

and calculate the technological capacity A(t) of the 10 provinces and municipalities in 1983; the results of the figures, arranged in order, will be: 2.9175 in Dalian, 2.4071 in Shanghai, 1.9686 in Wuxi, 1.7351 in Tianjin, 1.6651 in Beijing, 1.5637 in Guangzhou, 1.5616 in Jiangsu, 1.3703 in Wuhan, 1.2611 in Shenyang, and 1.1903 in Fujian. It indicates that the technological capacity of the old industrial city Shanghai is greater than that of Tianjin, and that of the newly emerged cities such as Dalian and Wuxi is also greater than Tianjin with a big gap.

In Figures 6 and 7, K represents the net growth of fixed assets; Y, the growth of the output of the industry; L, the growth of the staff and worker contingent; A, the growth of the technological progress coefficient; and E, the growth of the number of S&T personnel. From Figure 6, one can clearly see that

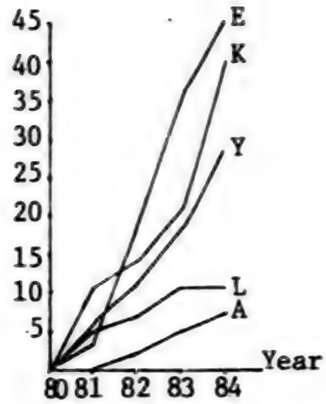

Figure 6. Relationship Among Tianjin Industrial S&T Personnel

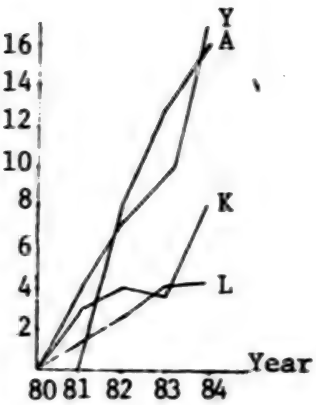

Figure 7. Relationship of Japanese Workers Union Members

E: Rate of growth
K: Fixed asset net value
Y: Total industrial output
L: Number of staff and workers
A: Technological progress coefficient

the increase in the number of Tianjin S&T personnel is a high, straightened curve. The growth of fixed assets and of the output of the industry after 1982 takes the lead. In particular, the growth of fixed assets surpasses that of the output of the industry. This is caused mainly by the factories, such as in greater investment to alter the old enterprise and the rapid growth of investment in introducing advanced technology from foreign countries through decentralized foreign exchange; the expanded autonomy of the enterprises; accumulated growth; and the growth of purchases of fixed assets. There is no denying that in the Seventh 5-Year Plan period, economic results will be created. However, it surely does not conform to economic laws to have too much growth of fixed assets. From Figure 7 we know that technological progress in Japan (A) has been obviously leading and its growth is not only greater than the growth of the fixed assets and the total number of staff and workers, but also higher than that of total output value.

The overall urban plan passed by the Third Conference of the Tianjin People's Congress in 1985 clearly indicates that one of the major tasks in industry during the Seventh 5-Year Plan period is to rearm traditional industry and the current enterprises with new technology and give energetic support to the development of new industry to meet the requirements of the new technological revolution, in the hope that by 1990, the proportions of technology-intensive industry and new industry will increase from 18.7 percent and 0.7 percent in 1985 to 23.1 percent and 1.7 percent, respectively.

Along with the economic adjustment in Tianjin, there are five critical problems with an S&T contingent which urgently need to be solved. They are: to raise the quality of the current S&T personnel; to cultivate urgently needed

professionals with a purpose; to strengthen the technological force in the forefront of production; to pay attention to the middleaged and young S&T backbones in cultivation to create the necessary conditions for talent to show itself; and to adjust the professional structure and distribution of the S&T personnel according to economic development.

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S&T RESULTS FROM SIXTH 5-YEAR PLAN

Tianjin KEXUEXUE YU KEXUE JISHU GUANJI [SCIENCE OF SCIENCE AND MANAGEMENT OF S&T] in Chinese No 9, Sep 86 pp 30-32

[Article by Xu Rongcheng [1776 2837 2092] from the Shanghai Navy Medical Science Institute: "Statistical Analysis of S&T Results from Sixth 5-Year Plan"]

[Text] This article provides a statistical analysis of the structure, cycle, person topic index, and units included from 2,340 items of S&T results, with a better understanding of current research topics in our country and a reference for topic management and assessment.

I. Source of Data

The data are adopted from SCIENCE AND TECHNOLOGY RESEARCH RESULT BULLETIN Nos 1-12, 1984. This bulletin started in June 1981 and is a restricted publication announcing S&T results registered at the National Science Commission to promote the interchange and application of the results. In 1983, 5,400 items of important S&T research results were acquired in the country and those published in the bulletins[1] in 1984 consisted of only half of the total number which have been examined and recommended by the related departments and are the parts with higher standards and results. The disciplines include the professions of natural science, engineering, medical science and agriculture, basic learning, and other professions, with their research results catalogued and announced. These include the results from the CAS system, colleges and universities, provincial and municipal departments, and the enterprises. These results represent a wide range of disciplines and levels. The accumulated results in the past have been sorted out and most of those announced in 1984 are items accomplished 1 or 2 years before, which are able to reflect the general situation of the research topics in the Sixth 5-Year Plan.

II. Structure of the Topics

Ever since UNESCO divided scientific research into basic research, application research, and development research, it gradually has become an international classification with wide applications in the calculation of the proportion of S&T research allocations. Owing to differences of interpretation and the difficulty in practical topic classification, there appear many methods such as applicable basic research, application and development research, theory

Table 1. Composition of Results Reported in 1984 Bulletin

Bulletin number	Basic science results (items)*	Other science results (items)	Total (items)
1	25	171	196
2	31	173	204
3	20	180	200
4	13	187	200
5	19	182	201
6	16	177	193
7	26	174	200
8	33	170	203
9	17	182	199
10	14	183	197
11	22	175	197
12	15	135	150
Subtotal	251	2,089	2,340
Percent	10.7	89.3	100

*In the bulletin, mathematics, physics, chemistry, astronomy, geography, and biology are listed as fields of basic learning, and all the other disciplines are listed as "others."

research, product research, probing research, and innovative research. To facilitate understanding and implementation, I offer in this article a classification according to the nature of the result:

1. Discovery research: It includes basic research and basic application research; it is mainly a form of research which opens up new knowledge about nature. The results it offers are new discoveries, new theories, new laws, new forms of understanding, hypotheses, monographs, experiments and observations, theoretical probes, investigations, and analyses. These appear in the form of research theses; the combination of number and quality of these papers represents the S&T potential and storage of that country.

2. Software research: Borrowing this concept from computer software, this indicates that the results of this kind of research include soft scientific results and the soft results of natural science. The forms of these kinds of results are projects, procedures, technology, regulations, crafts, standards, methods, designs, opinions, and data bases. In the development of modern science and an in-depth technological revolution, applicable soft results attract more and more attention, whose situation represents the level of management and S&T development of that country.

3. Product research: This includes research on material objects such as application research and development research. The results are new species, new instruments, new equipment, new materials, new installations, new medicines, new reagents, new tools, and new articles for use. The level of product research represents the ability to digest and utilize modern S&T and the level of results of S&T in economic and social construction in that country.

The structural characteristics shown in Table 2 indicate that discovery, software, and product research is equal to 18:23:59 (which is equal to 1:1.5:3.5) and are connected to the level of the current economic development in our country. If the results of one kind can be divided into several grades according to the extent of innovation, the macroscopic structural characteristics of each kind of research can be further expressed in quantity. There are different structures in the proportion of basic, application, and development research in different countries and at different times. Zhao Tonggang, et al., in their investigation of some of the results in medical science, obtained the proportion of 14:72:14, respectively; the proportion of S&T research allocation in the United States in the seventies was 14.8:22.7:62.5, and the proportion in present day Soviet Union is 14:22:64.[2-3] Also, some others say that in recent years, Japan and West Germany have obtained more results in their industrial product research; the United States and Britain occupy a dominant position in creative research results at the level of the Nobel prize award, and for this reason the Japanese Government and S&T circles are engaged in examination and formulation measures to strengthen creative research. Thus we see that in the harmonized development of the science of assessment and control, and social and economic coordination, topic structure is an important index.

Table 2. Type Distribution of 2,340 Items of Results (Percent)

	Number of results	Percent
Discoveries	411	17.6
Software	536	22.9
Products	1,393	59.5
Subtotal	2,340	100

III. Person-topic Index

The person-topic index is the average of the number of people who carry out the projects. The overall index of the 2,000 results is 5.4 person-topics, among them, 5 person-topics in basic science research, and 5.5 person-topics in other areas of research. Classified according to the three types of research (Table 3), the index of the discovery type research is 4.7 person-topics; software type, 5.3 person-topics; and product type, 6.3 person-topics, with an obvious increase in the number of people. In fact, there is divergence in grasping the undersigned; some are the principal persons in charge and some are all the people who participated. There are still 276 topics (11.8 percent) underwritten by the department which will have only a certain effect on the person-topic analysis.

Statistics from Yale University indicate that in 1900, the number of theses written by individuals amounted to 80 percent of the total collection in the CHEMISTRY DIGEST, and in 1960 it dropped to 35 percent. The number of theses written by two or more increased correspondingly. D. Price regards this change as a scientific collective-cooperative movement.[4] It is thus clear that the person-topic index is a comprehensive index which connects with the difficulty and comprehensiveness of the topic, the standard of cooperative management, and the progress of development of the S&T from small-scale S&T towards large-scale S&T.

Table 3. Person-Topic Index of 2,340 Items of Results (Percent)

Person-topic	Discovery research	Software research	Product research	Σ
1	25.1	6.5	4.6	8.6
2-3	28.9	29.6	25.5	27.1
4-5	18.0	27.4	24.5	24.0
6-7	7.0	12.6	14.4	12.7
8-9	6.1	5.9	7.0	6.6
10-19	5.8	7.5	8.3	7.7
20-29	0.3	1.2	1.1	0.98
Above 30	1.9	0.2	0.2	0.51
Only name of unit given	6.8	9.1	14.3	11.8
Subtotal	100	100	100	100

Table 4. Distribution of Units With Results Reported (Percent)

Type	1 unit	2-5 units	6-10 units	10 or more units	Σ
Basic sciences	75.9	21.3	1.6	1.2	100
Other sciences	57.7	39.1	2.8	0.4	100
Subtotal	59.6	37.4	2.6	0.5	100

IV. Units Joined the Research

The number of units participating in research has the same significance as the person-topic index; it also indicates the strengthening of ties among the different disciplines in the S&T research and the integration of S&T research, production, and application. The basic form of S&T research in our country now is a topic of research done by the individual unit (Table 4) and it is more true in basic research (75.9 percent). Co-research involving two or more units amounts to slightly more than two-fifths; the tendency of increase in co-research should catch the attention of the management authorities.

V. Research Cycle

S&T research is nonrepetitive,one-time production and time is a decisive factor in that result. Table 5, the shortest research cycle is 3 months and the longest is 35 years (to breed a new species of horse), and the average is 3.7 years per topic. Among them, topics with a cycle of 1.1-5 years amount to 69.71 percent, and of more than 5 years, 28.72 percent. In the calculation, we found that there are difficulties and reasons with some of the long-cycle topics; however, some are "unworthy topics" introduced through poor administration, and still there are 39 topics that do not mention time spent (1.67 percent), which I am afraid belong to this category.

Table 5. Distribution of Time Used in Research

Research time used (years)	Percent
Within 0.5 year	2.18
0.6-1	7.88
1.1-2	23.56
2.1-3	22.63
3.1-4	14.71
4.1-5	8.81
5.1-10	14.40
10.1-20	3.07
20.1-30	1.02
30 years or longer	0.17
Time spent unknown	1.67
Σ	100.00

VI. Economic Results

To summarize the results in the bulletin and count those results marked "popularized and utilized in some provinces and municipalities," "utilized in several factories with good results," "used in practice to solve some problems," and "in production and sale in market," they amount to 13.3 percent. The results of published S&T theses, monographs, standards, experimental methods, and investigation reports amount to 8.78 percent. The two combined make a total of 517 items and are 22.09 percent of the total, which are considered results which have created (even partially) economic results.

The time interval from the accomplishment to the registration of most of the results in the bulletin is about 2 years, which provides a reference for us to calculate the delayed time of the results. In the United States, it generally takes 4 years for a chemical engineering product to be put out on the market from its laboratory and it takes much longer in the Soviet Union.[5] The results introduced are not all industrial products and the economic results mentioned above are not all the producer's and the user's results. The result-delay-time of 2-3 years is for reference to calculate "the researcher's result."

VII. Conclusion

A statistical analysis of the 2,340 topics accomplished during the Sixth 5-Year Plan is given and preliminary results are obtained as follows:

1. Topic structure with discovery research: software research: product research = 1:1.5:3.5.

2. Average person-topic index is 5.4 percent-topics; the number of topics done by 2-5 people amounts to 51.1 percent of the total.

3. Average topic cycle is 3.7 years per topic; topics with a cycle of 1.1-5 years amount to 69.71 percent.

4. Topic co-researched by two or more units amounts to 40.4 percent of the total, with a tendency to increase.

5. About 22.09 percent of the results have definitely obtained economic results; based on this calculation, the result delay is 2-3 years.

FOOTNOTES

1. National Statistics Bureau, "Bulletin on the Results of the Execution of the 1983 National Economic and Social Development Plan," JIEFANG RIBAO, April 1984, p 2.

2. Zhao Tonggang [6392 0681 0474], et al., "Report on the Investigation of S&T Results at the Chinese Medical Institute," SCIENCE OF SCIENCE AND MANAGEMENT OF S&T, No 3, 1986, pp 40-44.

3. Hu Lezhen [5170 2867 4076], "Economic Problems in Scientific Research," Mechanics and Engineering Publications, 1985, pp 87-118.

4. D. Price, translation by Song Jiangeng [1345 0494 5087], et al., "Small Science and Large Science," World Science Publications, 1982, pp 53-79.

5. E. Chaliskey, translation by Wang Enguang [3769 1869 0342], "The Russian Policy on Science," Science Publications, 1981, pp 394-398.

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BRIEFS

JIANGSU SPARK PLANS--Thirty-nine "spark plans" in Jiangsu Province, with the joint efforts of the province, cities, and counties, have been entirely determined and have begun to be implemented. Total investment in these projects is 74.08 million yuan. There are 95 subprojects within this group, including the 5 initial areas of growing, breeding, and processing, rising new technologies, new textile products, rural housing construction, and production equipment. Because of full demonstrations beforehand, these projects are technically distinct, advantageous in resources, short in duration, and results will be quick. Ninety-five percent of the projects will be finished in 1988. It is predicted that after the 39 projects are completed, the ratio of anticipated economic results put into production to that generated will be 1:7.4. Right now, the 39 projects have generally reached the point of the "four implementations" (the responsible unit implementation, develop substance and open up the dimensions implementation, technical and economic indexes implementation, and the funding implementation), and some of the projects have already made progress of varying degrees. [Text] [Shanghai WEN HUI BAO in Chinese 30 Aug 86 p 1] 12586

CSO: 4008/2011

NUMERICAL SIMULATION OF STORM SURGES IN THE EAST CHINA SEA

Qingdao SHANDONG HAIYANG XUEYUAN XUEBAO [JOURNAL OF SHANDONG COLLEGE OF OCEANOLOGY] in Chinese Vol 15, No 3, 15 Sep 85 pp 40-47

[Article by Wang Jingyong [3076 2529 1661], Department of Marine Physics]

[Text] Introduction

China's coast is often ravaged by Pacific typhoons, in which large losses of life and property are caused by anomalous rises in sea level. The area affected by typhoon storm surges includes the South China Sea and East China Sea. Weather service forecasts generally make use of the comparison (or similarity) method, in which a historical sample is chosen with reference to some standard: for example, such major factors affecting the rise in water level as the place where the typhoon reaches land, its path and speed, the maximum pressure at its center, and the radius of the area with force 6 winds are used to select a historical sample of typhoons resembling the one under consideration. A comparative analysis of the observed rises in water level caused by the typhoons in the sample and of the characteristics of the typhoon under study is used to determine the probable rise in water level [1]. Errors in storm surge predictions result from the fact that the historical sample is incomplete and the estimates of some of the key characteristics are inaccurate. But an effective numerical model could be used to fill in the gaps in the historical sample, thus aiding weather service forecasts.

Numerical simulations of storm surges are extensively used for sea areas of the temperate zone, for example the North Sea off Western Europe. In 1981, Flather described a numerical model used for the purpose by the United Kingdom's weather service [2]. A model designed by Jelesnianski [3] is used for forecasts in the Gulf of Mexico. Johns and Ali [4] used a numerical model to simulate storm surges in the Bay of Bengal. Subsequently, Johns and his co-workers used several improved models to simulate storm surges on the east coast of India [5-8].

Many numerical simulations of storm surges have also been made in China. Feng Shizuo and Sun Wenxin [9] have performed many simulations for Bohai Bay. In a

recent talk on oceanology, Qin Zenghao [4440 2582 3493] summarized recent Chinese progress in storm surge research and described the prospects of numerical simulation.

Below we describe a numerical model and use it to simulate storm surges near the mouth of the Changjiang River, making an initial attempt to take account of the effect of high waters in the river. This area, which includes Shanghai, is generally affected by typhoon storm surges. Following a serious flood in 1949, various protective measures were taken, including reinforcing the 5.8-meter embankment along the Huangpujiang River.

A new high-water record was set on 1 September 1981 as a result of the combined effect of a storm surge from typhoon 8114 (Agnes) and high tides. At that time the highest water level at Wusong station was 5.7 m. This event indicated the great importance of accurately forecasting storm surge levels in the Shanghai area: the combined effect of typhoons, river discharge and high tides can produce water levels higher than the embankments.

Below we describe trial calculations from data on typhoons 8114 and 7413 and present the results for typhoon 8114. The model used is similar to that of Johns and Ali [4], but also takes the discharge of the Changjiang River into account. It does not take account of the interaction of tides with storm surges because tidal data are not available for the East China Sea. The computation results are satisfactory. Plots of the calculated rise in water level over time are in good agreement with observations, indicating that the model is of some value and merits further study and improvement

II. The Numerical Model

We used Cartesian coordinates $O_{x,y,z}$ and neglected the curvature of the earth. The origin of coordinates O was placed at the undisturbed sea surface. Axes O_x and O_y were directed eastward and northward respectively, while O_z was directed vertically upwards. The sea bottom was represented by $z = -h(x, y)$ and the location of the disturbed sea surface was $z = \zeta(x, y, t)$. Neglecting the effect of astronomical tides, the depth-averaged flow speed components u and v satisfy the equations

$$\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} - fv = -g\frac{\partial \zeta}{\partial x} - \frac{1}{\rho}\frac{\partial p_a}{\partial x} + \frac{1}{H\rho}\left\{\tau_x^{\zeta} - k\rho u(u^2 + v^2)^{1/2}\right\} \quad (1)$$

$$\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + fu = -g\frac{\partial \zeta}{\partial y} - \frac{1}{\rho}\frac{\partial p_a}{\partial y} + \frac{1}{H\rho}\left\{\tau_y^{\zeta} - k\rho v(u^2 + v^2)^{1/2}\right\} \quad (2)$$

where p_a is the atmospheric pressure, H is the total water depth (equal to $\zeta + h$), f is the Coriolis parameter, $\left\{\tau_x^{\zeta}, \tau_y^{\zeta}\right\}$ is the wind stress at the sea surface, the bottom friction term is, as usual, proportional to the square of the speed, ρ is the density of the fluid, and K is the friction coefficient.

The continuity equation for an incompressible liquid can be written

$$\frac{\partial \zeta}{\partial t} + \frac{\partial}{\partial x}(Hu) + \frac{\partial}{\partial y}(Hv) = 0 \qquad (3)$$

The area for which the computation is made is part of the East China Sea, as shown in Fig. 1. The origin of coordinates is located at its southwest corner, at 27° N, 120° E. The main computation area is a rectangle that is 615 km wide from east to west and 960 km long from north to south. The grid spacing is 15 km, so that the mouth of the Changjiang River and the complex coastline near Shanghai cannot be effectively represented. A small computation subarea is therefore inserted into the main computation area, as shown in Fig. 1. Its southwestern corner is located at 30.5° N, 121° E, and it measures 191 km from east to west and 203 km from north to south. This subarea allows a correct representation of the mouth of the Changjiang River and Chongming Island.

The model also includes the Changjiang and Huangpujiang Rivers by connecting one-dimensional models of the river channels to the sea model. If x is the curvilinear distance along the main navigational channel starting at the river mouth, then the average flow speed u and the water level ξ satisfy the equations

$$\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} = -g\frac{\partial \zeta}{\partial x} - \frac{ku|u|}{H} \qquad (4)$$

$$b\frac{\partial \zeta}{\partial t} + \frac{\partial}{\partial x}(Hbu) = 0, \qquad (5)$$

The direct effect of atmospheric pressure and winds at the sea surface is neglected in equation (4). In equation (5), b represents the width of the river at a distance X upstream.

The solutions of the river model and sea model must be reconciled at the point where they join. This location is expressed as follows

$$\zeta_r = \frac{1}{b}\int \zeta_s \, dy,$$

$$b[(\zeta + h)u]_r = \int [(\zeta + h)u]_s \, dy,$$

(r indicates rivers, s indicates the sea).

The details of the seacoast in the vicinity of the Changjiang mouth are shown in Fig. 2. The smaller grid in the subarea correctly represents Chongming Island and the seacoast at the mouth of the Changjiang River. In the one-dimensional flow models of the Changjiang and Huangpujing, adjoining water level computation points are located 30 and 15 km apart respectively. The Changjiang is represented as being 26 km wide at its mouth, with the width

gradually decreasing to 7.5 km at the [simulated] source 135 km upstream. The speed at the source was calculated from the discharge, for which we used a figure of 46,000 m^3/sec, representing the average summer discharge. The discharge of the Huangpujiang River was neglected. The Huangpujiang is represented as 67 km long, with zero flow speed at its source.

Alternating grids were used in both the main computation area and the subarea. The seacoast is represented by a broken line consisting of line segments running either east to west or south to north, and the flow speed perpendicular to the coast is assumed to be zero. Adjoining computation points of the same type in the subarea are 7.5 km apart.

The method by which the solutions for the main area and the subarea are reconciled is very important. Two methods are currently in common use. One, first used by Das [10] in 1974, involves bidirectional interaction at the corresponding points in the large and small computation areas. The method used here is similar to that of Flather [2]: the water level at the boundary of the subarea is equated to the water level at the corresponding point in the main area. The computation grid for this area includes the location of the subarea, but with adjoining points of the same type spaced 30 km apart. Thus the complex coastline near Shanghai is ignored, and a recalculation must be made for the subarea. This approach required a large amount of computation, but it demonstrated that with the chosen subarea, the different coastal water levels obtained for the main area and the subarea had no significant effect on the water level at the boundary. Our trial calculations indicated that the subarea described here meets this requirement.

Another problem is that of choosing boundary conditions for the surrounding sea area. It is desirable that these conditions be so chosen that disturbances within the area can propagate freely from the boundary. We used the radiative boundary conditions that are employed extensively in Europe:

$$
\begin{aligned}
&v + (g/h)^{1/2}\zeta = 0 && \text{at the southern boundary} \\
&v - (g/h)^{1/2}\zeta = 0 && \text{at the northern boundary} \qquad (6) \\
&u - (g/h)^{1/2}\zeta = 0 && \text{at the eastern boundary.}
\end{aligned}
$$

Using boundary conditions (6), we made trial calculations for computation areas of different sizes and discovered that further expanding the size of the computation area had no significant effect on the calculated water levels near the mouth of the Changjiang River.

We now describe the computation method. We start from an initial state in which t = 0. We include in our computations the calculated river discharge but not the effect of the atmospheric pressure and wind stress of the typhoon. We integrate the controlling equations, reaching a steady state directly. This result represents the flow speed and water level for the specified river discharge value.

If an appropriate bottom friction coefficient is chosen, this steady-state solution generally can be reached by integrating over a simulation period of 72 hours. The result may be used as the initial state for a computation that takes account of wind stress.

Before making the calculations, we estimated the effect on the water level produced by atmospheric pressure alone; it proved to be smaller than the effect of wind stress. We did not include the atmospheric pressure and wind stress in the model simultaneously because it is very difficult to find simultaneous wind field and atmospheric pressure field equations that agree with observations and also are dynamically compatible. Our approach was to make an additional calculation that included only the atmospheric pressure field and excluded the wind stress and river discharge, allowing us to estimate the rise in water level produced by atmospheric pressure alone; this result was then used as a correction factor.

Following Isozaki's suggestion [11], the atmospheric pressure field was specified by the equation

$$P_a = P_\infty - \Delta P/[1 + (r/R_1)^2]^{1/2}. \tag{7}$$

where P_∞ is the atmospheric pressure at sea level along the perimeter of the typhoon, ΔP is the pressure drop in the typhoon, R_1 is the radius of the area of maximum wind speed, and r is the distance from the center of the typhoon.

The parameters of equation (7), calculated from data on typhoon 8114 furnished by the Shanghai Meteorological Station, were ΔP = 61 mbar, R_1 = 150 km. The atmospheric pressure distribution along the typhoon's path calculated from equation (7) is shown in Fig. 3.

The above method of handling the atmospheric pressure involves the assumption that the effect of wind stress adds in linear fashion to the effect of atmospheric pressure.

Using the grid layout described and the sea bottom topography in the East China Sea (obtained from British charts of the seas bordering China), a steady-state solution can be obtained with a time step of 3 minutes.

III. The Numerical Experiment

The main objective of our numerical experiment was to estimate the change in water level caused by typhoon 8114. On 1 September 1981 the center of the typhoon was at sea 150 km east of Shanghai. The path of its center from 26 August to 5 September is shown in Fig. 3.

The numerical experiment involved integration over 48 hours of simulation time. The time t = 0 represents 0800 hours Beijing time on 30 August, when the center of the typhoon was 750 km southeast of Shanghai. Based on

observational data provided by the Shanghai Meteorological Office, the wind speed at the sea surface was approximated by the equations

$$
\begin{aligned}
&v = v_1[r/R_1]^{3/2}, && \text{for} \quad r < R_1 \\
&v = \frac{(r - R_{i+1})(v_i - v_{i+1})}{R_i - R_{i+1}} + v_{i+1}, && \text{for} \quad R < r \leqslant R_{i+1} \quad (i = 1,2,3) \\
&v = \frac{(r - R_4)(v_3 - v_4)}{R_3 - R_4} + v_1, && \text{for} \quad R_4 < r \leqslant R_5 \\
&v = 0, && \text{for} \quad r > R_5 \ .
\end{aligned}
\tag{8}
$$

In these equations, v is the wind speed at the sea surface, R_1 is the radius of the largest wind circle, R_2, R_3 and R_4 are the radii of the circles containing winds of force 10, 8 and 6 respectively on the Beaufort scale, and R_5 is the radius of the area affected by the typhoon, given by the equation

$$R_5 = R_4 + \frac{(R_4 - R_3)\cdot v_4}{v_3 - v_4} . \tag{9}$$

In this equation, v_1 is the maximum wind speed, and v_2, v_3 and v_4 are wind speeds of 10, 8 and 6 on the Beaufort scale. Based on data for typhoon 8114, we chose the values R_1 = 150 km, R_2 = 275 km, R_3 = 500 km, R_4 = 675 km, v_1 = 46 m/sec, v_2 = 28 m/sec, v_3 = 21 m/sec, v_4 = 14 m/sec. The center of the typhoon followed the path shown in Fig. 3. The surface wind stress was assumed, as usual, to be proportional to the square of the wind speed, and the value of $2.8\cdot10^{-3}$ was chosen for the friction coefficient.

Equation (8) was used because it agrees well with other simplified wind field equations and with observational data and does not require a great deal of computer time.

One further parameter, the bottom friction coefficient R, must also be specified. Our numerical experiments indicated that when calculating the change in water level resulting from storm surges in the East China Sea, values of the coefficient between 10^{-3} and $5\cdot10^{-3}$ had little effect on the calculated water level values, but had a distinct effect on the calculated flow speed. Qin Zenghao [12] has noted than in shallow seas this coefficient is larger than the value of $2.5\cdot10^{-3}$ that is commonly used. Comparison with the Johns three-dimensional model [7] indicated that a value of $4.0\cdot10^{-3}$ was best for the bottom coefficient in the East China Sea, and this value was therefore used in the computations.

As noted above, we calculated a steady-state water level distribution for the case in which only river discharge was considered. The water level at Wusong station at the mouth of the Huangpujiang River was 0.24 m. The maximum calculated rise in water level occurred at t = 34 hours, at which time the rise resulting from atmospheric pressure alone was 0.14 m. These figures were

used as correction values when comparing the calculated rise in water level with the actual values.

The results obtained by considering only river discharge were used for the initial value at t = 0, with the typhoon's center at its position of 0800 hours on 30 August as shown in Fig. 3, and integration was performed for a simulation time of 48 hours.

The calculated values for the 30-hour period between 0200 hours on 31 August and 0800 hours on 1 September are compared with the observed water levels at Wusong station in Fig. 4. In the calculation results, the water level rose rapidly starting at 2000 hours on 31 August, reaching the maximum level of 1.95 m at 2200 hours the same day, and falling to about 1.5 meters at 2000 hours on 1 September. The observational data indicate that the maximum rise was 1.86 m and occurred at dawn on 1 September, representing a difference of about 2 hours from the calculated figure. The calculation results are in good agreement with the observations.

Although we were concerned primarily with predicting water levels at Wusong station, it is also important to consider the large-area water level distribution. Fig. 5 shows the water level contours for typhoon 8114. The wind stress and river discharge, but not the effective atmospheric pressure, were considered in the calculations for this map. Significantly, the high water appeared in an inshore strip where the depth was less than 10 m. Far from shore, the water level decreased with increasing sea depth.

The isochrones for the times of appearance of peak water levels are shown in Fig. 1. It is apparent that the changes in water level move in wavelike fashion. The numbers next to the curves in the figure indicate the times (in hours) of appearance of the peak water levels. The storm surge wave propagated 550 km northward in 6.5 hours. It can also be seen that the times of appearance of peak water levels were later near shore than far from shore. The reason may be that in shallow water there is greater bottom friction to retard propagation of the waves. Finally, it is evident that the calculated time of appearance of the peak water level at Wusong is later than the time of appearance outside the mouth of the Changjiang. This is because a certain amount of time is required for the wave to propagate upstream to Wusong.

IV. Conclusions

We used a depth-averaged numerical storm surge model to simulate the East China Sea under the influence of a Pacific Ocean typhoon. The influence of the Changjiang River's discharge is included in the model. Data on typhoon 8114 were used to simulate the rise in water level at Wusong station. The calculated water-level results for a large area show wavelike propagation. The numerical calculation indicates that the phase velocity of the wave is about 23 m/sec. One explanation currently offered for the rise in the water level near shore during storm surges is that when the waves from a remote disturbance reach the coast, the amplification effect of shallow water

produces high water levels close to shore. It is evident from the computation results presented above that there is some truth in this explanation.

A method of predicting storm surges based on historical data is generally used in China, but there are many gaps in the historical data. If the numerical model presented here were used to calculate the rises in water level produced by all possible types of typhoon, it would provide an excellent supplement to this prediction method.

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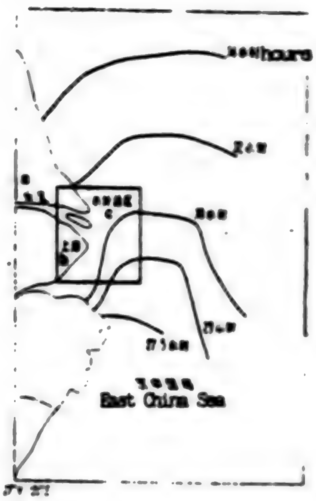

Fig. 1. Calculation area and waves in it

Key: a. Changjiang River
b. Shanghai
c. Computation subarea

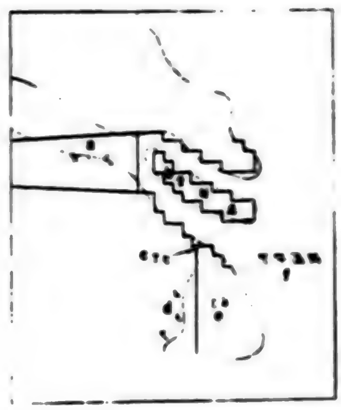

Fig. 2. Modeled and actual physiography near Shanghai

Key: a. Changjiang River
b. Songming Island
c. Wusong
d. Huangpujiang River
e. Shanghai
f. East China Sea

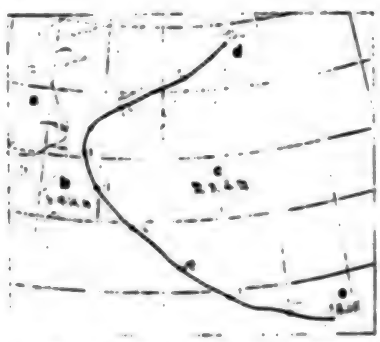

Fig. 3. Path of the center of typhoon 8114

Key: a. China
b. East China Sea
c. Pacific Ocean
d. 5 September
e. 26 August

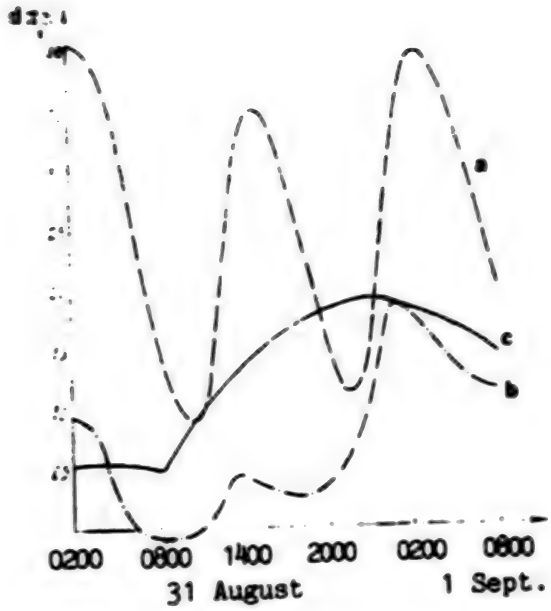

Fig. 4. Rise in water level at Wusong

Key: a. Predicted water level
b. Actual rise in water level
c. Calculated rise in water level
d. Water level, m

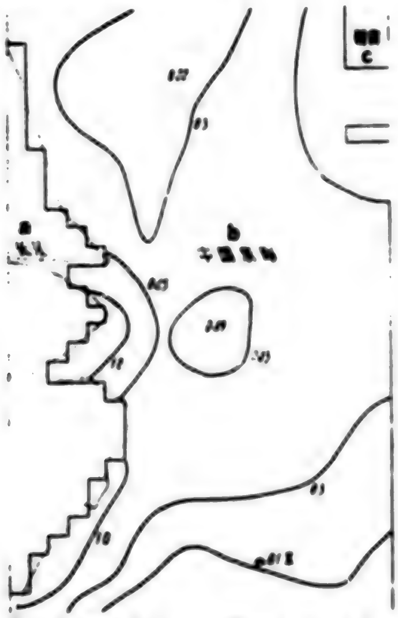

Fig. 5. Contour lines for rise in water level

Key: a. Changjiang River c. Korea
b. East China Sea

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MATHEMATICAL MODEL OF STEADY-STATE CIRCULATION IN THE SOUTH CHINA SEA

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[Article by Wang Jia [3769 0163], Institute of Oceanology, Chinese Academy of Sciences: "A Model of Steady-State Circulation in the South China Sea"; manuscript received 25 June 1984]

[Text] I. Introduction

The South China Sea is the largest and deepest sea area on China's coast, and Chinese and foreign investigators have made several studies of it [1, 2]. Xu Xizhen [1776 6932 4394] et al. [3] used a dynamic computation method to study its horizontal circulation and produced the first four-season multilayer average density flux chart for the area (Figs. 2A and 2B use the results of this dynamic calculation). The circulation given for the 500-meter layer (i.e. the middle layer) in Xu's article is essentially in agreement with the value for the surface layer, showing that in the South China Sea the circulation extends to a considerable depth, with circulating movement still clearly evident at depths of at least 800 meters. The 1200-decibar surface was chosen as the zero-speed surface for the dynamic calculation.

However, although the dynamic calculation method indicates the circulation movements, it does not reveal all of the factors that control them. Consequently, when using the dynamic method to investigate the circulation in the South China Sea, the dynamic mechanisms must be elucidated. The present paper extends the β-plane [4,5] wind curl-thermohaline gradient model [6] to a model representing the actual South China Sea area as a multiply connected region and simulates the winter and summer circulation in the sea. The calculations take account of wind stress, the thermohaline effect, bottom topography, and boundary forces. A fast convergence technique was used in the calculations, and nonlinear effects were further elucidated on the basis of the linear model.

II. Controlling Equations

A factor analysis based on the geography, climate and hydrologic conditions of the South China Sea yields a set of dynamic equations that include the thermohaline effect:

$$-\rho f v = -\frac{\partial p}{\partial x} + \rho \frac{\partial}{\partial z}\left(\nu \frac{\partial u}{\partial z}\right) , \tag{1}$$

$$\rho f u = -\frac{\partial p}{\partial y} + \rho \frac{\partial}{\partial z}\left(\frac{\partial v}{\partial z}\right) , \tag{2}$$

$$0 = -\frac{\partial p}{\partial z} - \rho g . \tag{3}$$

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0 . \tag{4}$$

$$\frac{\partial(\rho u)}{\partial x} + \frac{\partial(\rho v)}{\partial y} + \frac{\partial(\rho w)}{\partial z} = \frac{\partial}{\partial z}\left(k_z \frac{\partial \rho}{\partial z}\right) . \tag{5}$$

where the origin of coordinates is at the sea surface, with the x axis directed eastward, the y axis northward, and the z axis vertically upward. Integrating equation (3) from some depth Z to the surface ζ, we obtain

$$p = p_0 + g\int_z^\zeta \rho dz , \tag{6}$$

Substituting into equations (1) and (2), we obtain

$$\int_z^\zeta \rho dz = \int_z^0 \rho dz + \int_0^\zeta \rho_0 dz = \rho_0 \zeta + \int_z^0 \rho dz . \tag{7}$$

Introducing the total volume flow and the total mass flow,

$$\vec{S} = \int_{-H}^{\zeta} \vec{v} dz . \tag{8}$$

$$\vec{M} = \int_{-H}^{\zeta} \rho \vec{v} dz . \tag{9}$$

We integrate equations (1), (2), (4) and (5) from -H to ζ and apply the sea-surface boundary condition $z = \zeta$,

$$p = p_0 , \quad w_\zeta = u_\zeta \frac{\partial \zeta}{\partial x} + v_\zeta \frac{\partial \zeta}{\partial y} ; \tag{10}$$

$$\rho_0 \nu \frac{\partial u}{\partial z} = \tau_{ax}, \qquad \rho_0 \nu \frac{\partial v}{\partial z} = \tau_{ay} ; \tag{11}$$

$$k_z \frac{\partial \rho}{\partial z} = \Gamma_a \, . \tag{12}$$

and the sea-bottom boundary condition $z = -H$:

$$W_H = u_H \frac{\partial(-H)}{\partial x} + v_H \frac{\partial(-H)}{\partial y} ; \tag{13}$$

$$\rho_0 \nu \frac{\partial u}{\partial z} = \tau_{bx} = \frac{c}{H} S_x ; \tag{14}$$

$$\rho_0 \nu \frac{\partial v}{\partial z} = \tau_{by} = \frac{c}{H} S_y ; \tag{15}$$

$$k_z \frac{\partial \rho}{\partial z} = \Gamma_b \approx 0 \, . \tag{16}$$

We then obtain the following group of equations for the total flow:

$$f \times \vec{M} = -\nabla(p_a + \rho_0 g \zeta)(H + \zeta) - \vec{F} + \vec{\tau}_a - \vec{\tau}_b , \tag{17}$$

$$\nabla \cdot \vec{S} = 0 \, , \tag{18}$$

$$\nabla \cdot \vec{M} = \Gamma_a \, . \tag{19}$$

where $\vec{\tau}_a$, $\vec{\tau}_b$ represent the wind force at the sea surface and the friction force on the sea bottom, Γ_a is the thermohaline effect, and $\vec{F}$ is the integral horizontal density gradient term, i.e.

$$\vec{F} = \left(g\int_{-H}^{\zeta} \left[\int_{-H}^{z} \frac{\partial \rho}{\partial x} d\eta\right] dz , \; g\int_{-H}^{\zeta} \left[\int_{-H}^{z} \frac{\partial \rho}{\partial y} d\eta\right] dz \right) . \tag{20}$$

We introduce the total stream function

$$\vec{S} = \vec{k} \times \nabla \psi , \tag{21}$$

and linear bottom friction assumptions (14) and (15), where $\vec{k}$ represents the unit vector along the z axis and C is the friction coefficient. Taking the cross derivatives of the two components of equation (17) and subtracting one from the other, then applying equations (18), (19), (14), (15) and (21), for the case in which $H \gg \zeta$, we obtain the controlling equation for the stream function in the β-plane,

$$\frac{c}{H}\Delta\psi + \frac{\rho_0 f}{H} J(H,\psi) - \frac{2c}{H^2}(\nabla H \cdot \nabla \psi) + \rho_0 \beta \frac{\partial \psi}{\partial x} = \mathrm{rot}_z \vec{\tau}_a +$$

$$\frac{1}{H}\left(\frac{\partial H}{\partial y}\tau_{ax} - \frac{\partial H}{\partial x}\tau_{ay}\right) + \left(\frac{\partial F_x}{\partial y} - \frac{\partial F_y}{\partial x}\right) + \frac{1}{H}\left(\frac{\partial H}{\partial x}F_y - \frac{\partial H}{\partial y}F_x\right) - f\Gamma_a . \tag{22}$$

The corresponding boundary condition is

$$\psi|_{\Omega_0} = \psi_s(x,y) \ , \tag{23}$$

i.e.

$$s_s = \begin{cases} 0 & \text{when } \Omega_0 \text{ is a land boundary} \\ s_s & \text{when } \Omega_0 \text{ is a water boundary} \end{cases} \tag{24}$$

In addition, we require that

$$\oint_{\Omega_0} s_s dl = 0 \ . \tag{25}$$

where Ω_0 is the lateral boundary and dl is a line element in Ω_0. Δ in equation (22) is the horizontal Lagrangian, and the second and third terms are respectively

$$J(H,\psi) = \frac{\partial H}{\partial x}\frac{\partial \psi}{\partial y} - \frac{\partial H}{\partial y}\frac{\partial \psi}{\partial x} \ . \tag{26}$$

$$(\nabla H \cdot \nabla \psi) = \frac{\partial H}{\partial x}\frac{\partial \psi}{\partial x} + \frac{\partial H}{\partial y}\frac{\partial \psi}{\partial y} \ . \tag{27}$$

The first term on the right side of each of these equations is the curl of the wind stress, while the second term represents the coupling between the bottom topography and the wind stress. When the direction of the wind stress coincides with the direction of the bottom topography gradient this term is zero. The third and fourth terms represent the combined effect of baroclinicity and bottom topography, while the final term represents the thermohaline effect.

Consider the actual boundary of the South China Sea: Hainan Island is separate from the continent and is larger than the spacing of the computation grid. In the present article it is therefore treated as a multiply connected region. Designating the boundary of Hainan Island by Ω_1, the solution of the stream function can be written

$$\psi = \psi_0 + c_1\psi_1 \ , \tag{28}$$

where ψ_0 is the solution of equation (22) with boundary condition $\psi_0|_{\Omega_1} = 0$, $\psi_0|_{\Omega_0} = \psi_s$, while ψ_1 is the solution of the homogeneous part of equation (22) with the boundary conditions $\psi_1|_{\Omega_1} = 1$ and $\psi_1|_{\Omega_0} = 0$.

To determine c_1, both sides of equation (17) are dot-multiplied by dl, after which we integrate around Ω_1:

$$\oint_{\Omega_1} \frac{f}{\rho g H}(\vec{k} \times \vec{M}) \cdot \vec{dl} = -\oint_{\Omega_1} \nabla\zeta \cdot \vec{dl} + \oint_{\Omega_1} \frac{1}{\rho g H}(\vec{\tau}_s - r\vec{s}) \cdot \vec{dl} - \oint_{\Omega_1} \frac{\vec{F}}{H} \cdot \vec{dl}. \tag{29}$$

Using the boundary conditions $M_n = 0$ and $\oint_{\Omega_1} \nabla\zeta \cdot \vec{dl} = 0$, taking x as the average depth and using the condition $\oint_{\Omega_1} \Delta\rho \cdot \vec{dl} = 0$, we find that the last term on the right side of the equation is equal to zero; then, applying Green's formula, we find that the term on the left is also equal to zero, so that the equation becomes

$$\oint_{\Omega_1} \frac{\tau_s}{k^2} dl = \oint_{\Omega_1} \frac{\gamma}{k^2} s \, dl = \oint_{\Omega_1} \frac{\gamma}{k^2} \frac{\partial \Psi}{\partial n} ds \ . \tag{30}$$

Substituting equation (28) into equation (30), we obtain

$$\oint_{\Omega_1} \frac{\tau_s}{k^2} dl = \oint_{\Omega_1} \frac{\gamma}{k^2} \left(\frac{\partial \Psi_0}{\partial n} + c_1 \frac{\partial \Psi_1}{\partial n} \right) dl. \tag{31}$$

Here, $\gamma = C/H$, $k^2 = gH$, τ_s is the tangential wind stress around Ω_1, and n is the internal normal to the boundary Ω_1. It follows from equation (31) that c_1 is determined by the wind field distribution, flow field and water depth around the islands.

III. Numerical Model and Computation Method

The calculation area was covered with a 1° x 1° square grid (Fig. 1), with $\Delta Y = 110 \cdot 10^5$ cm, $\Delta X = \Delta Y \cos\varphi$. The grid calculations (using an alternating grid) and the difference scheme (a 5-point scheme) are described in Ref. 7. The truncation error for both is $O(h^2)$, so that equation (22) can be converted to the corresponding difference equation

$$a_{i,j}\Psi_{i,j} + b_{i,j}\Psi_{i,j-1} + c_{i,j}\Psi_{i-1,j} + d_{i,j}\Psi_{i+1,j} + e_{i,j}\Psi_{i,j+1} = Q_{i,j} \ , \tag{32}$$

where $a_{i,j} \cdots e_{i,j}$ are functions of the water depth and the wind stress, and $Q_{i,j}$ is the external force at node (i, j); it can be shown that a 5-point difference scheme represented by this type of ordinary second-order elliptical equation converges as $O(h^2)$ [8].

The calculation is performed by the successive overrelaxation (SOR) method, starting with a G-S iteration; the calculation yields a (k+1)-th approximation value that is the weighted average of the (k+1)-th intermediate result $\bar{\Psi}_{i,j}^{(k+1)}$ and the value of $\Psi_{i,j}^{(k)}$ from the previous iteration,

$$\Psi_{i,j}^{(k+1)} = \omega \bar{\Psi}_{i,j}^{(k+1)} + (1-\omega)\Psi_{i,j}^{(k)} \ , \tag{33}$$

where ω is the relaxation factor (generally, $1 < \omega < 2$). In order to speed up

convergence and save on computer time, the optimum value of ω must be chosen automatically. We therefore write the equation relating the characteristic value η of the iteration matrix to the characteristic value λ_{rs} of the simple iteration matrix

$$\eta - \omega\lambda_{rs}\eta^{1/2} + \omega - 1 = 0 \, . \tag{34}$$

η depends on the relaxation factor ω and λ_{rs}; we write it $\eta_{rs}(\omega)$. If λ_{rs} is real and $|\lambda_{rs}| < 1$, then the value of ω that minimizes $\max|\eta_{rs}(\omega)|$ is

$$\omega_{opt} = 2/(1 + \sqrt{1 - \lambda_{rs}^2}) \, . \tag{35}$$

We can use a computer to choose the optimum value of ω automatically from equations (34) and (35). The values of ω that we calculated generally were about 1.4, giving a precision of 10^{-7}.

IV. Data and Parameters

Fig. 1 is a physiographic map of the South China Sea, which adjoins the Taiwan Strait on the north and communicates with the Pacific Ocean via the rather deep Bashi Channel in the northeast; it connects with the Sulu Sea both north and south of Palawan Island and in the south it adjoins the Java Sea along the Sunda continental shelf. The entire calculation area is in low latitudes. At the center of the sea is a diamond-shaped basin containing an abyssal plain about 4,300 m deep. The average depth of the South China Sea is about 1,180 m and the maximum depth exceeds 5,000 m.

The South China Sea is an area in which the northeastern and southwestern monsoons alternate. The former generally appears between October and March, and the latter between May and September. Both monsoons have their strongest winds on the meridional axis of the basin: 6-9 m/sec for the winter monsoon, and 5-8 m/sec for the summer monsoon. The wind field data were taken from a collection of charts published in the Netherlands [8]; reference was made to relevant South China Sea wind field data. Some boundary conditions were based on dynamic calculation results,* and some were based on field data or estimates of surface flow, with correction for the discharge of the Zhujiang, Meigonghe, Meinanhe and Honghe Rivers.

The friction coefficient C was chosen as 2.4-3.0. Since H is of the order of 1,000 m, C/H is then about 10^{-5}; their magnitudes thus satisfy the condition $10^{-6} \leq C/H \leq 10^{-4}$. Calculation of the wind stress and thermohaline effect are described in reference 7. We chose a value of 400g/cm-sec for K_y.

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* These were provided by Comrade Huang Qizhou [7806 0120 3166] of the South China Sea Institute of Oceanology, Chinese Academy of Sciences, for which we here express our gratitude.

V. Conclusions and Discussion

A. Winter Circulation

1. The general circulation calculated from this model (see Fig. 3; here and below, the computed values should be multiplied by 10^{10} cm^3/sec) are in rather good agreement with the dynamic calculation results presented in reference 3 (Fig. 2A). The entire sea area is controlled by a large cyclonic circulation; there are also three smaller circulations, namely cold anticyclonic eddies in the southern and northern sections of the area and a rather small warm anticyclonic eddy in the central section. The northward current in the eastern section tends to compensate water losses from the northern section. Part of a branch of the Kuroshio entering through the Bashi Channel flows into the South China Sea, while another part flows through the Taiwan Strait or returns to the main Kuroshio current.

2. The entire South China Sea, and especially the deep-water area, is controlled primarily by the baroclinic field. The circulation obtained by ignoring the actual wind field, shown in Fig. 4, is essentially in agreement with Fig. 3, although the magnitudes are smaller, indicating that the baroclinic field is the leading factor.

3. The effect of the wind is less important than the baroclinic effect (in the deep-water area). The circulation obtained by considering only the effect of the actual wind field, shown in Fig. 5, does not agree with Fig. 3.

4. The bottom topography strongly restricts the baroclinic field in this sea area and is an essential factor determining the circulation. Fig. 6 shows the circulation obtained on the assumption of a flat bottom, which disagrees with the circulation shown in Fig. 3: in particular, the eddies in the southern and central sections disperse, which not only indicates the importance of bottom topography, but also proves that the combined effect of bottom topography and baroclinicity is the main factor controlling the overall circulation.

5. Small changes in the friction coefficient produce only small changes in the calculated circulation values (the figure is not included).

B. Summer Circulation

The overall summer circulation, shown in Fig. 7, generally agrees with the dynamic calculation results in Fig. 2B. The overall circulation system is the opposite of the winter situation, since it consists of an anticyclonic flow. It includes three rather large eddies. In the south, a rather strong high-temperature, high-salinity current enters from the Java Sea, flows northeastward, and combines with Indochinese coastal waters. This branch of the current is blocked and turned by a rather strong cold eddy on the Vietnamese coast, which it bypasses, turning farther northward. Some of this current bends southward and combines with a southwestward current along the coast of

Kalimantan Island, forming a rather long anticyclonic circulation in this area. A rather small closed cyclonic circulation forms in Beibu Wan Bay, owing primarily to a density current that is caused to flow southward by the nonuniform southwesterly winds and the large discharge in the northern part of the basin. This result agrees with observations and theoretical analyses. After the discharge of the Zhujiang River enters the sea, it is driven or buttressed by a northeastward flow field and generally southerly winds, so that it turns northeastward.

Comparing the summer circulation with the winter circulation, we note the following.

1. The summer baroclinic field has an absolute controlling effect on the circulation. This is because it is stronger than the winter baroclinic field. The circulation obtained by considering only the baroclinic effect, shown in Fig. 8, basically agrees with Fig. 7.

2. The wind stress is less important than the baroclinic field. Because the southwestern summer monsoon is weaker than the northeastern winter monsoon, the baroclinic field is the opposite. The circulation pattern obtained by considering only the wind stress, shown in Fig. 9, is quite different from that in Fig. 7.

3. The bottom topography is a basic factor which must be taken into consideration.

In addition, if the wind stress and baroclinic effect are neglected and only boundary force effects are taken into account (Fig. 10), the flow field that is obtained is completely different from that in Fig. 7, and the entire summer circulation disappears; this situation resembles only that in Fig. 9. Fig. 11 shows the result of considering the baroclinic field but not the boundary forces; it does not agree with Fig. 7. Thus it is evident that sea water exchanged through straits (i.e., the boundary forces) directly affects the circulation in the South China Sea and must not be neglected.

The area in which the water of the Zhujiang River diffuses can be seen in Figs. 7-10. It diffuses the farthest southward when only boundary forces are considered, while the next most extensive diffusion is obtained when winds blowing generally from the south (opposing winds) are considered; with baroclinicity considered, the diffusion is considerably restricted. We may thus infer that diffusion of the discharge from the Zhujiang River is controlled chiefly by the baroclinic field in the adjoining sea area, while the next most important factor is the strength and direction of the wind.

The flow field obtained by neglecting the beta effect (i.e. by using the f-plane model) is almost the same as that obtained when the beta effect is taken into account; the differences in magnitude are very small (figure not included). The main reason for this situation is that the beta-effect term in

equation (22) is more than an order of magnitude smaller than the topography-variation term, a fact which also proves the importance of bottom topography.

We should note that the nonlinear terms have only a minor effect in this model. The nonlinear results that we calculated for the summer (Fig. 12) essentially agree with Fig. 7, but the magnitudes are somewhat different; these conclusions are in agreement with the results of dimensional analysis. Because the South China Sea is of oceanic dimensions and the Rossby number is 10^{-3}, the effect of the nonlinear terms is not distinctly manifested; thus the linear model effectively simulates the dynamic characteristics of circulation in the South China Sea.

To summarize, our simulation of the winter and summer circulation in the South China Sea has provided preliminary information on its dynamic characteristics, as well as casting light on winter and summer circulation characteristics and providing dynamic information for future, more thorough studies. The principal limitation of the present paper is that the baroclinic field for the entire sea area is not presented.

We thank Comrade Zhang Zenghui [1728 1073 6540] for drawing the figures.

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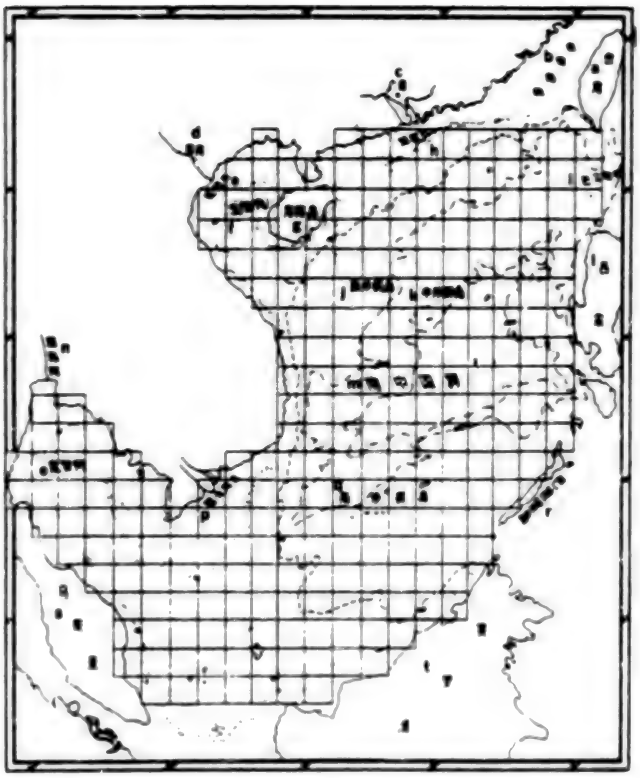

Fig. 1. Topography of the South China Sea and computation grid

Key: a. Taiwan
b. Taiwan Strait
c. Guangzhou
d. Hanoi
e. Mouth of Red River
f. Beibu Wan
g. Hainan Island
h. Mouth of Zhujiang
i. Bashi Channel
j. Xisha Islands [Paracels]
k. Zhongsha Islands [Paracels]
l. Luzon
m. South China Sea
n. Menan River
o. Gulf of Siam
p. Mouths of Mekong River
q. Nansha Islands [Spratlys]
r. Palawan Island
s. Malaya
t. Borneo

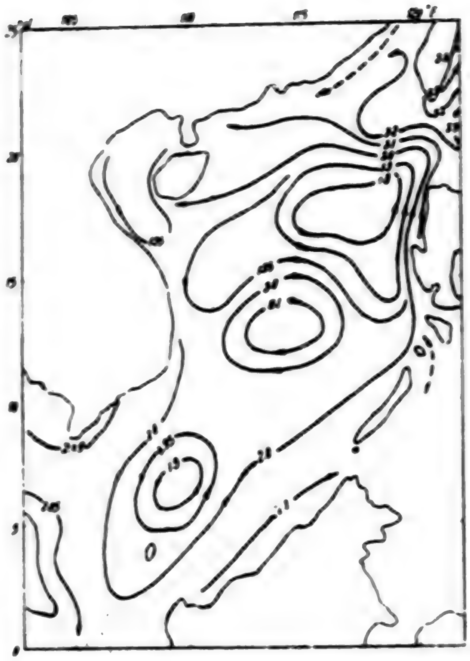

Fig. 2A. Density currents in surface layer, December-February

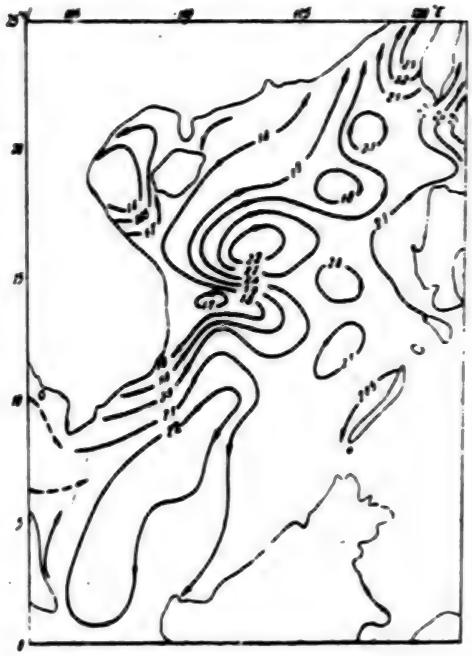

Fig. 2B Density currents in surface layer, June-August

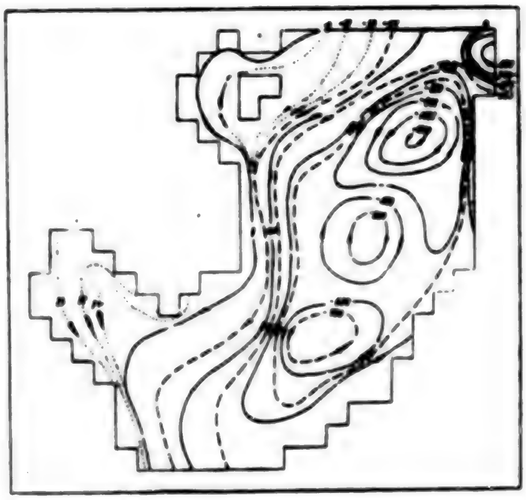

Fig. 3. Winter circulation with allowance for baroclinicity, actual bottom topography, and actual wind field, C = 2.4

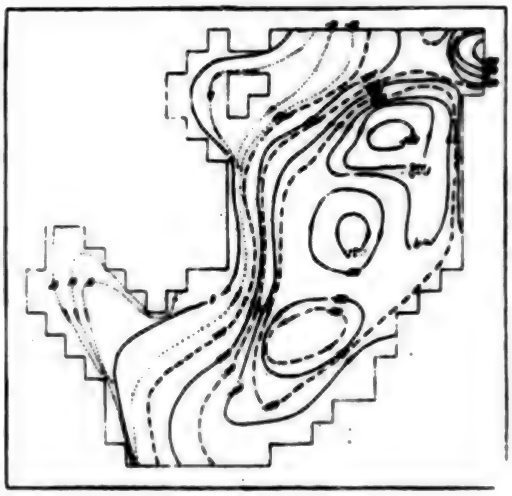

Fig. 4. Winter circulation with allowance for baroclinicity and actual bottom topography, no wind field, C = 2.4

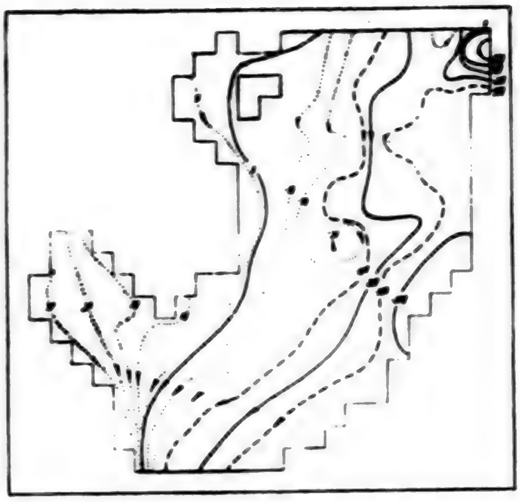

Fig. 5. Winter circulation (barotropic, actual bottom topography, actual wind field, C = 2.4

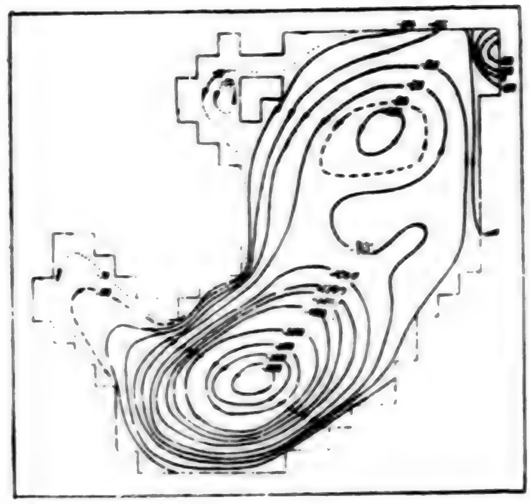

Fig. 6. Hypothetical model of winter circulation with allowance for baroclinicity, flat bottom, no wind field, C = 2.4

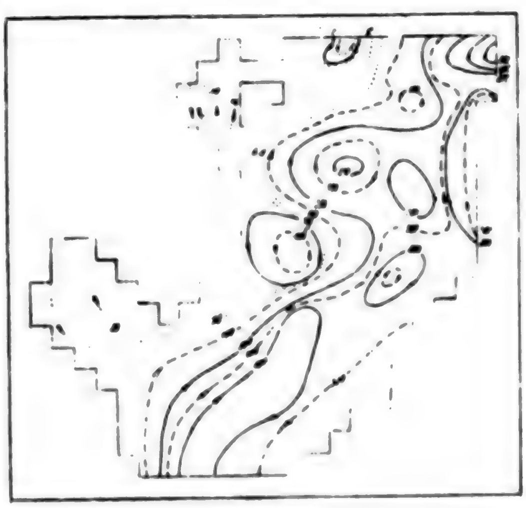

Fig. 7. Summer circulation with allowance for baroclinicity, actual bottom topography, actual wind field, C = 3

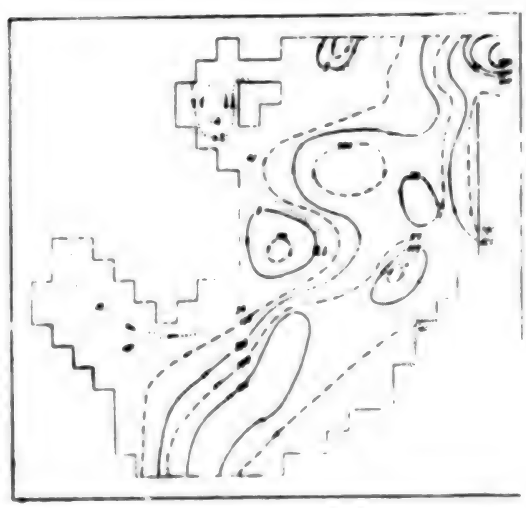

Fig. 8. Summer circulation with allowance for baroclinicity, actual bottom topography, no wind, C = 3

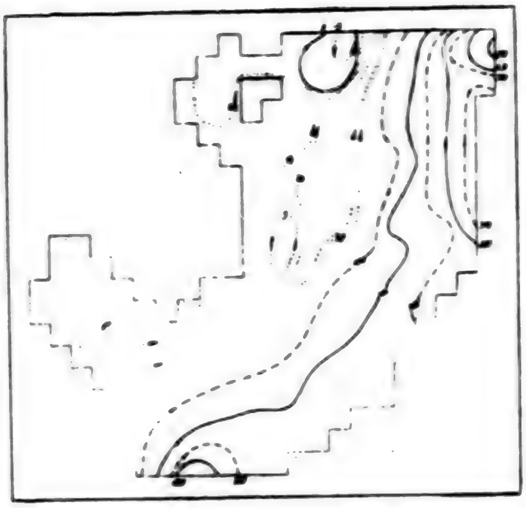

Fig. 9. Summer circulation (barotropic, actual bottom topography, actual wind field, C = 3)

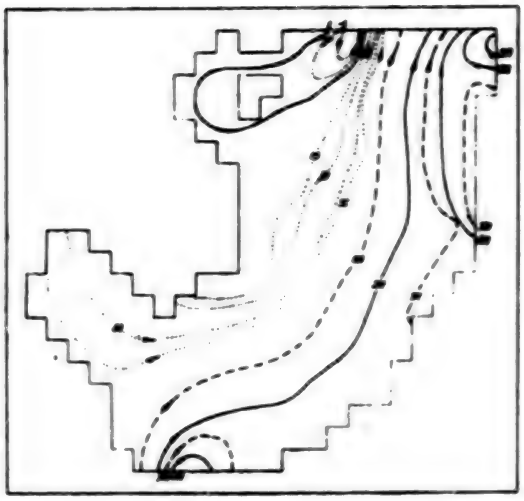

Fig. 10. Hypothetical model of summer circulation (barotropic, actual bottom topography, no wind, C = 3)

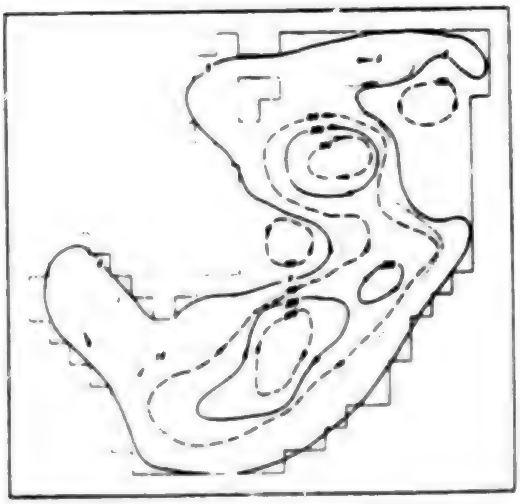

Fig. 11. Hypothetical model of summer circulation with allowance for baroclinicity, actual bottom topography, no boundary forces, C = 3.

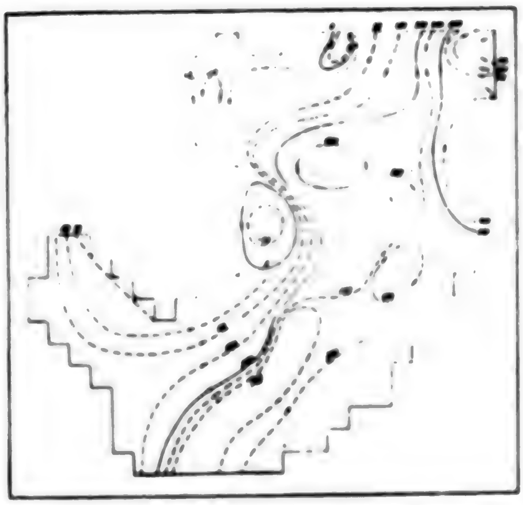

Fig. 12. Summer circulation with allowance for baroclinicity, actual bottom topography, actual wind field, C = 3, horizontal flow term included.

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CSO: 4008/1053

DETAILS OF F-8 II PRESENTED

Beijing GUOJI HANGKONG [INTERNATIONAL AVIATION] in Chinese No 11, Nov 86 p 5

[Text] The F-8 II is a Chinese-built single-seat, twin-engine, high-performance supersonic fighter aircraft. It is primarily used for defending against high-speed enemy aircraft at both high and low altitudes; it can also be used for deploying air-to-ground weapons.

The aircraft has a thin delta wing design. The movable horizontal tail is attached to the fuselage below the wing surface; it is used for pitch control as well as roll control. The vertical tail with a large back-sweep is attached to the rear section of the fuselage. A foldable ventral fin is located on one side of the fuselage to improve directional stability.

The intake ducts of the engines are located on two sides of the fuselage. The wedge angle of the intake duct plates can be automatically adjusted according to the Mach number and the engine pressure ratio. The large nose section of the aircraft and the electronics compartment contain a modern fire control system.

There are two spoilers located beneath the fuselage at both the front and rear sections. A braking chute is located at the base of the vertical tail.

The primary structural material of the aircraft is aluminum alloy; the components under heavy load are made of high-strength steel, and the parts subject to high temperatures are made of titanium alloy. Also, honeycomb structures are used extensively.

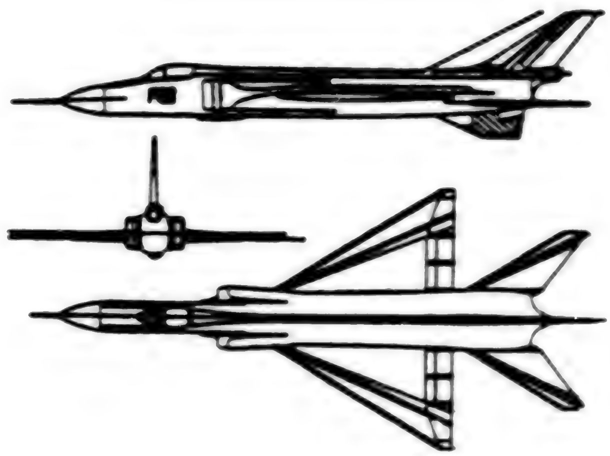
The F-8 II is powered by two high-thrust engines. The flight control system is equipped with an autopilot for controlling attitude, direction, altitude, and for improving stability. It has two independent hydraulic systems. The power supply system provides both AC and DC power.

It has two air and climate control systems; one is used for air-conditioning in the cockpit, the other is used for cooling the radar room.

The aircraft is also equipped with a UHF/VHF single side-band radio station, a radar altimeter, a radio beacon, as well as an aircraft discriminator, a radar early-warning receiver, and interference rejection equipment.

The fire control system of the aircraft consists of a radar, an optical aiming device, and a gun camera.

The weapon system of the aircraft consists of twin cannons and seven external attachment points which can accommodate infrared missiles, radar-guided missiles, rockets, bombs, and auxiliary fuel tanks.



Three Views of the F-8 II

Key Technical Data of the F-8 II Aircraft

Length	21.59 m
Wing span	9.344 m
Height	5.41 m
Weight empty	9,820 kg
Normal takeoff weight	14,300 kg
Maximum takeoff weight	17,800 kg
Internal fuel capacity	4,200 kg
Maximum design Mach number	2.2
Design speed limit	1,300 km/hr
Service ceiling	20,000 m
Range	2,200 km

3012/9365
CSO: 4008/24

STUDY ON DGF AT SOURCE REGION IN CIRCULAR WAVEGUIDES (I)

Beijing DIANZI KEXUE XUEKAN [JOURNAL OF ELECTRONICS] in Chinese Vol 8 No 1, Jan 86 pp 14-22

[English abstract of article by Pan Shenggen [3382 3932 2704], Shanghai University of Science and Technology]

[Text] This is the first part of our work on the dyadic Green's functions (DGF) at the source region in circular waveguides. In this paper, a systematic and novel approach is developed for the dyadic operation of DGF. The complete forms of the dyadic operation of DGF for circular waveguides are given. Ambiguities associated with the dyadic operation in the literature are clarified and the errors are redressed.

Contrary to Kisliuk (1980, 1983), it is shown that the expansion of the longitudinal vector eigenfunctions **L** and the expansion of the transverse vector eigenfunctions **M** and **N** are not purely longitudinal and transverse fields at the source region. In addition, it is also shown that the interchanging differential and integral operators to carry out the dyadic operation of DGF is invalid at the source region (Tai, 1973). (Paper received 21 May 1984, revised 19 August 1985.)

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CSO: 4009/1046

INFLUENCE OF LASER RECRYSTALLIZATION, PLASMA HYDROGEN ANNEALING ON ELECTRICAL PROPERTIES OF POLYSILICON

Beijing DIANZHI KEXUE XUEKAN [JOURNAL OF ELECTRONICS] in Chinese Vol 8 No 1, Jan 86 pp 45-51

[English abstract of article by Fang Fang [2455 5364], Lin Chenglu [2651 2052 7627], Shen Zongyong [3088 1350 7167], and Zou Shichang [6760 0013 2490], Shanghai Institute of Metallurgy, Chinese Academy of Sciences]

[Text] Asenic ions are implanted with doses of 5×10^{11} - 5×10^{15} cm^{-2} into LPCVD polysilicon films on SiO_2 substrate, which have been recrystallized with CW Ar^+ laser before implantation. Electrical measurements show that its resistivity is lowered and its mobility is increased significantly at low doping concentration (10^{17} As^+ cm^{-3}). Plasma hydrogen annealing is performed on laser recrystallized samples. The electrical characteristics of plasma hydrogen annealed samples are close to that of single-crystalline silicon. Based on the existing theoretical models for conduction in polysilicon, a new formula for large grain polysilicon has been proposed, with help of which a good agreement between the theory and experimental results is achieved in the range of doping concentration from $10^{16}cm^{-3}$ to $10^{20}cm^{-3}$.

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CSO: 4009/1046

DCT METHOD FOR IMAGE DATA COMPRESSION

Beijing DIANZI KEXUE XUEKAN [JOURNAL OF ELECTRONICS] in Chinese Vol 8 No 1, Jan 86 pp 60-63

[English abstract of article by Xu Yaochang [6079 5069 2490] and Ping Xijian [1627 6007 1696], Beijing Institute of Aeronautics]

[Text] A set of computation formulas of discrete doxine transform (DCT) for image data compression is given. The results of simulation experiment show that the formulas are correct and consistent with the formulas given by W.K. Pratt (1978), but they are different slightly in form. (Paper received 20 January 1984, revised 13 November 1984.)

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CSO: 4009/1046

NEW $PbTiO_3$ PIEZOELECTRIC CERAMICS MODIFIED WITH $(Pb_{1/2}Ni_{1/2})MnO_3$

Beijing DIANZI KEXUE XUEKAN [JOURNAL OF ELECTRONICS] in Chinese Vol 8 No 1, Jan 86 pp 76-80

[English abstract of article by Sun Xuanren [1327 1357 0088], Zhang Fubao [1728 4395 1405], and Deng Qiguang [6772 0366 0342], Guangzhou Communications Institute]

[Text] A kind of $PbTiO_3$ piezoelectric ceramics modified with $(Pb_{1/2}Ni_{1/2})MnO_3$ is recommended. It possesses fine VHF performances. Its coupling factor k_t is 0.48; mechanical quality factor Q_M is high; and frequency stability is good.

With the above mentioned material, we have assembled a 62 MHz bandpass filter which consists of seven vibrators. Its stop-band attenuation reaches 30 dB; insertion loss is 6 dB; the ripple ratio of passband is 0.5 dB; while the rectangular ratio is 3.4.

The depolarization phenomenon appearing in this kind of $PbTiO_3$ ceramics is discussed. It is proposed how to overcome the depolarization phenomenon. And it is thought that this kind of ceramics may be an ideal material for developing $PbTiO_3$ surface wave devices. (Paper received 16 May 1984, revised 4 February 1985.)

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CSO: 4009/1046

ESTIMATION THEORY, RATE DISTORTION THEORY

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14 No 4, Jul 86 pp 45-49

[English abstract of article by Shi Guiqing [4258 6311 7230] and Xu Bingzheng [1766 4426 6927], South China Institute of Technology, Guangzhou]

[Text] The lower bound of the probability of error estimation was presented by Bahadur. In this paper its upper bound and another proof of the lower bound are presented. Then rate distortion theory is obtained by using Neyman-Pearson theorem. (Paper received February 1986, revised.)

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CSO: 4009/1044

CHERNOFF'S BOUND OF PROBABILITY FOR CORRECT ESTIMATION

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14 No 4, Jul 86 pp 55-59

[English abstract of article by Shi Guiqing [4258 6311 7230] and Xu Bingzheng [1766 4426 6927], South China Institute of Technology, Guangzhou]

[Text] A definition of the exponent B(d) of the probability for correct estimation is given, and a Chernoff's bound of the probability of correct estimation is obtained by using the exponent in the case of both random and nonrandom parameters. (Paper received January 1986, revised March 1986.)

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CSO: 4009/1044

SPECTRUM METHOD FOR CORRELATION ANALYSIS OF NONLINEAR GENERATOR

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14 No 4, Jul 86 pp 78-84

[English abstract of article by Xiao Guozhen [5135 0948 6966], Northwest Telecommunication Engineering Institute, Xi'an]

[Text] This paper discusses the difficulty in cryptoanalysing the crypto-system using binary sequences generated by several linear feedback shift registers with nonlinear combination logic as the key system. The concept of linear statistical independence is defined for the combination function. It is the first attempt of the author to use Walsh functions and spectrum analysis in studying this problem.

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Ti-DIFFUSED $LiNbO_3$ WAVEGUIDE INTERFEROMETRIC MODULATORS

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14 No 4, Jul 86 pp 114-115

[English abstract of article by Huang Zhangyong [7806 4545 0516], Zheng Neng [6774 5174], and Yang Dewei [2797 1795 0251], Chongqing Optoelectronic Research Institute]

[Text] An interferometric modulator with Ti-diffused $LiNbO_3$ waveguide has been fabricated. Measurements are made at the optical wavelength of 0.6328 μm. The results are as follows: π phase voltage 5.3V, maximum modulation degree of 97.6 percent, capacitance 9 pF and 3 dB bandwidth 700 MHz. The response characteristics are measured at different bias voltages using the sine wave signal of 300 kHz. (Paper received November 1984, revised May 1985.)

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SIMULATION SYSTEM AT REGISTER TRANSFER LEVEL ON DOMESTIC MINICOMPUTER

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14 No 4, Jul 86 pp 116-117

[English abstract of article by Jin Suigeng [6855 4840 2577], Gan Junren [3927 7486 0086], Wang Yuzhen [3769 3768 3791], and Wu Yueli [0702 2588 5461], Shanghai Institute of Metallurgy, Chinese Academy of Sciences]

[Text] The SIMCDL is a simulation system implemented on a domestic minicomputer system. The hardware description language is based on CDL (Computer Design Language). The whole system is written in Fortran. The calculation of the labels is optimized by several new means and some advanced software techniques, such as minimum perfect hashing function, etc., are included. (Paper received April 1985, revised December 1985.)

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VERIFICATION ON OBJECT OF MAIN LENS IN CAMERA TUBE BEING CROSS-OVER

Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 14 No 4, Jul 86 pp 123-125

[English abstract of article by Zheng Yucai [6774 3768 2088]]

[Text] By means of theoretical analysis, computer calculation, experimental test and evaluation of modulation transfer function, the object of main lens in camera tube is found to be cross-over and not aperture. The aperture only acts as limiting diaphragm. (Paper received January 1985.)

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